Guardmaster MSR57P Speed Monitoring Safety Relay

User Manual

(Catalog Number 440R-S845AER-NNL)

ALLEN-BRADLEY • ROCKWELL SOFTWARE

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
SHOCK HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

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Preface

About This Publication 9
Who Should Use This Manual 9
Conventions 9
Terminology 9
Additional Resources 11

Chapter 1

Safety Concept

Introduction 13
Safety Certification 13
- Important Safety Considerations 14
- Safety Category 4 Performance Definition 15
- Stop Category Definitions 15
- Performance Level and Safety Integrity Level (SIL) 3 16

Functional Proof Tests 16
PFD and PFH Definitions 16
PFD and PFH Data 17
Safe State 17
Safety Reaction Time 18
Considerations for Safety Ratings 18
- Output Pulse Test Considerations 19
- Considerations for Single-encoder Applications 19

Contact Information if Device Failure Occurs 22

Chapter 2

About the MSR57P Speed Monitoring Safety Relay

Introduction 23
Safety Functions 23
- Safety Modes 24
- Disabled Mode 24
- Lock Monitoring 25
- Safe Maximum Speed, Safe Maximum Acceleration, and Safe Direction Monitoring 25

Hardware Features 26
Configuration 27

Chapter 3

Installation and Wiring

Introduction 29
General Safety Information 30
Environment and Enclosure 31
Considerations for Reducing Noise 31
Dimensions 31
Spacing Requirements 32
Mount the MSR57P Relay 32
Power Supply Requirements 32
Removable Terminal Blocks 33

Circuit Diagram 33
Terminal Connections 34
Compatible Encoders 35
Connect an Encoder 36
Encoder Cable Specifications 42
Feedback Cable Connections for Kinetix 2000, Kinetix 6000, Kinetix 7000 and Ultra3000 Drives 42
Flying-lead Feedback Cable Pin-outs 44
Wiring Low-profile Connector Kits 51
Feedback Connections for PowerFlex 70 Drives 52
Safe Off Board Terminal Block (Enhanced Control Only) 53
Encoder Interface Terminal Block (Enhanced Control Only) 53
Feedback Connections for PowerFlex 700S Drives 55
Connect a Configuration Device 55

Chapter 4

Speed Monitoring I/O Signals

Introduction 57
Inputs 57
Safe Stop Input (SS_In) 60
Safe Limited Speed Input (SLS_In) 60
Door Monitor Input (DM_In) 60
Enabling Switch Monitor Input (ESM_In) 61
Lock Monitor Input (LM_In) 61
Reset Input (Reset_In) 62
Reset Loop Input (RL_In) 63
Outputs 63
Safety Control Outputs 63
Diagnostic Outputs 70

Chapter 5

General Relay and Feedback Monitoring Configuration

Introduction 73
Cascaded Configuration 73
Safety Mode 74
Reset Type 74
Reset Qualification 75
Overspeed Response Time 75
Speed Resolution Accuracy for Rotary Systems 76
Speed Resolution Accuracy for Linear Systems 78
Language Code 79
Max Display Speed 80
General Parameter List 80
Feedback Monitoring 81
Feedback Polarity 82

Single Encoder 82
Dual Encoders 82
Feedback Voltage Monitor Range 85
Feedback Fault 86
Feedback Parameter List 86

Chapter 6

Safe Stop and Safe Stop with Door Monitoring Modes

Introduction 89
Safe Stop Mode 89
Safe Stop Types 90
Standstill Speed and Position Tolerance 93
Deceleration Monitoring 94
Safe Stop Reset 95
Door Control 97
Lock Monitoring 99
Safe Stop Parameter List 99
Safe Stop Wiring Example 102
Safe Stop with Door Monitoring Mode 102
Lock Monitoring 103
SS Reset 103
Safe Stop with Door Monitoring Parameter List 103
Safe Stop with Door Monitoring Wiring Example 104

Chapter 7

Safe Limited Speed (SLS) Modes

Introduction 105
Safe Limited Speed (SLS) Mode 105
Safe Limited Speed Reset 107
Safe Limited Speed Parameter List 108
Safe Limited Speed Wiring Example 109
Safe Limited Speed with Door Monitoring Mode 110
Safe Limited Speed Reset 111
SLS with Door Monitoring Parameter List 111
SLS with Door Monitoring Wiring Example 112
Safe Limited Speed with Enabling Switch Monitoring Mode . 112
Safe Stop Reset (SS Reset) and Safe Limited Speed Reset (SLS Reset) 113
SLS with Enabling Switch Monitoring Parameter List 114
SLS with Enabling Switch Monitoring Wiring Example 115
Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring Mode 115
Behavior During SLS Monitoring 117
Behavior While SLS Monitoring is Inactive 117
Behavior During SLS Monitoring Delay 117
Safe Stop Reset (SS Reset) and Safe Limited Speed Reset (SLS Reset) 118

SLS with Door Monitoring and Enabling Switch Monitoring Parameter List 118
SLS with Door Monitoring and Enabling Switch Monitoring Wiring Example 119
Safe Limited Speed Status Only Mode 119
Speed Hysteresis 120
SLS Status Only Parameter List 121
SLS Status Only Wiring Examples 122

Chapter 8

Slave Modes for Multi-axis Cascaded Systems

Introduction 125
Cascaded Configurations 125
Slave, Safe Stop Mode 127
Slave, Safe Stop Parameter List 127
Slave, Safe Stop Wiring Examples 129
Slave, Safe Limited Speed Mode 132
Slave, Safe Limited Speed Parameters 132
Slave, Safe Limited Speed Wiring Examples 133
Slave, Safe Limited Speed Status Only Mode 135
Slave, Safe Limited Speed Status Only Parameter List 135
Slave, Safe Limited Speed Status Only Wiring Examples . . . 135
Multi-axis Connections 137
Cascaded System Examples 139

Chapter 9

Safe Maximum Speed and Direction Monitoring

Introduction 145
Safe Maximum Speed (SMS) Monitoring 145
Safe Maximum Acceleration (SMA) Monitoring 148
Safe Direction Monitoring (SDM) 150
Max Speed, Max Accel, and Direction Monitoring Parameter List 151

Chapter 10

Safety Configuration and Verification

Introduction 153
Safety Configuration 153
Configuration Signature ID 153
Safety-lock 153
Set a Password 154
Reset the Password 155
Reset the Relay 155
Basics of Application Development and Testing 156
Commissioning the System 156
Specify the Safety Configuration 157
Configure the Speed Monitoring Relay 158
Project Verification Test 159

Confirm the Project 159
Safety Validation 159
Verify the Signature and Lock at the Speed Monitoring Relay 159
Editing the Configuration 160

Chapter 11

Configuration Examples

Introduction 161
Example Application 1 161
Example 1: Initial Security Group Settings 162
Example 1: General Group Settings 163
Example 1: Feedback Group Settings 164
Example 1: Stop Group Settings 166
Example 1: Limited Speed Group Settings 168
Example 1: Door Control Group Settings 169
Example 1: Max Speed Group 170
Example 1: Final Security Group Settings 171
Example Application 2 172
Example 2: Initial Security Group Settings 173
Example 2: General Group Settings 174
Example 2: Feedback Group Settings 175
Example 2: Stop Group Settings 177
Example 2: Limited Speed Group Settings 179
Example 2: Door Control Group Settings 181
Example 2: Max Speed Group 182
Example 2: Final Security Group Settings 183

Chapter 12

Troubleshoot the MSR57P Relay

Introduction 185
Status Indicators 185
Nonrecoverable Faults 186
Fault Recovery 187
Input and Output Faults 187
Fault Codes and Descriptions 187
Fault Reactions 190
Safe State Faults 190
Stop Category Faults and Fault While Stopping Faults . . 191
Status Attributes 192
Guard Status Attributes 192
I/O Diagnostic Status Attributes 195
Configuration Fault Codes 196

Specifications

Appendix A

Introduction 197
General Specifications 197
Environmental Specifications 198
Certifications 199
Encoder Specifications. 199

Parameter Data

Appendix B

Parameter Groups 201
Parameters and Settings in a Linear List 202

Using a HIM

Appendix C

Introduction 213
Connect a HIM Module 213
Setting Parameters with a HIM Module. 214
Accessing the Fault History Queue. 215

Use DriveExplorer or DriveExecutive Software

Appendix D

Introduction 217
Connect a Personal Computer 217
Using DriveExplorer Software 218
Configure Serial Communication. 218
Edit Parameters in DriveExplorer Software 219
Access the Fault History Queue 220
Using DriveExecutive Software 221
Configure Serial Communication. 221
Edit Parameters 224

Application Examples

Appendix E

Introduction 227
PowerFlex 70 Drive with Safe-Off Application Example . . . 228
PowerFlex 700 Drive without Safe-Off 231
Kinetix 6000 or Kinetix 7000 Drives with Safe-off Example . 233
Kinetix 2000 Drive without Safe-off Example 235

Index

About This Publication

This manual explains how the Guardmaster MSR57P Speed Monitoring Safety Relay can be used in Safety Integrity Level (SIL) 3, Performance Level [PL(e)], or Category (CAT) 4 applications. It describes the safety requirements, including PFD and PFH values and application verification information, and provides information on installing, configuring, and troubleshooting the relay.

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, configuring, or troubleshooting safety applications that use the MSR57P Speed Monitoring Safety Relay.

You must have a basic understanding of electrical circuitry and familiarity with relay logic. You must also be trained and experienced in the creation, operation, and maintenance of safety systems.

Conventions

In this manual, configuration parameters are listed by number followed by the name in brackets. For example,

P24 [OverSpd Response].

Terminology

The following table defines terms used in this manual.

Terminology

Abbreviation	Full Term	Definition
1oo2	One out of Two	Refers to the behavioral design of a dual-channel safety system.
CAT	Category	
DC	Door Control	—
DM	Door Monitoring	—
EN	European Norm	The official European Standard.
ESM	Enabling Switch Monitoring	—
ESPE	Electro-sensitive Protective Equipment	An assembly of devices and/or components working together for protective tripping or presence-sensing purposes and comprising as a minimum: • a sensing device. • controlling/monitoring devices. • output signal-switching devices (OSSD).
FMEA	Failure Mode and Effects Analysis	Analysis of potential failure modes to determine the effect upon the system and identify ways to mitigate those effects.
IEC	International Electrotechnical Commission	—

Terminology

Abbreviation	Full Term	Definition
IGBT	Insulated Gate Bi-polar Transistor	—
HFT	Hardware Fault Tolerance	The HFT equals *n*, where *n*+1 faults could cause the loss of the safety function. An HFT of 1 means that 2 faults are required before safety is lost.
HIM	Human Interface Module	A module used to configure a device.
LM	Lock Monitoring	—
MP	Motion Power	—
OSSD	Output Signal Switching Device	The component of the electro-sensitive protective equipment (ESPE) connected to the control system of a machine, which, when the sensing device is actuated during normal operation, responds by going to the OFF-state.
PC	Personal Computer	Computer used to interface with and program your safety system.
PFD	Probability of Failure on Demand	The average probability of a system to fail to perform its design function on demand.
PFH	Probability of Failure per Hour	The probability of a system to have a dangerous failure occur per hour.
PL	Performance Level	ISO 13849-1 safety rating
RL	Reset Loop	—
SDM	Safe Direction Monitoring	—
SFF	Safe Failure Fraction	The sum of safe failures plus the sum of dangerous detected failures divided by the sum of all failures.
SIL	Safety Integrity Level	A measure of a products ability to lower the risk that a dangerous failure could occur.
SLS	Safe Limited Speed	—
SMA	Safe Maximum Acceleration	—
SMS	Safe Maximum Speed	—
SS	Safe Stop	—

Additional Resources

This table lists publications that contain important information about safety systems that can use the speed monitoring safety functions of the MSR57P relay.

Resource	Description
Guardmaster MSR57P Speed Monitoring Safety Relay Installation Instructions, publication 440R-IN016	Provides information on installing the MSR57P relay.
HIM Quick Reference, publication 20HIM-QR001	A quick reference for using the HIM keypad.
DriveExplorer Online Help	DriveExplorer online help provides information on the release, quick start steps, general information about DriveExplorer software, descriptions of the elements in the DriveExplorer window, step-by-step procedures, and troubleshooting information.
PowerFlex USB Converter User Manual, publication DRIVES-UM001	Provides detailed information on installing, configuring, and troubleshooting the 1203-USB converter.
PowerFlex Smart Self-powered Serial Converter User Manual, publication 20COMM-UM001	Provides detailed information on installing, configuring, and troubleshooting the 1203-SSS series B serial converter.
PowerFlex 700S Phase II Drive User Manual, publication 20D-UM006	Provides detailed information on installing, wiring, programming, and troubleshooting PowerFlex 700S Phase II drives.
PowerFlex 700 Series A User Manual, publication 20B-UM001	Provides detailed information on installing, wiring, programming, and troubleshooting PowerFlex 700 Series A drives.
PowerFlex 700 Series B User Manual, publication 20B-UM002	Provides detailed information on installing, wiring, programming, and troubleshooting PowerFlex 700 Series B drives.
PowerFlex 70 User Manual, publication 20A-UM001	Provides detailed information on installing, wiring, programming, and troubleshooting PowerFlex 70 drives.
PowerFlex Reference Manual, publication PFLEX-RM001	Provides specifications and dimensions, as well as detailed information about drive operation.
DriveGuard Safe-Off Option (Series B) for PowerFlex 40P and 70 AC Drives User Manual, publication PFLEX-UM003	Provides detailed information installing, wiring, and operating PowerFlex 70 AC drives with the Safe-Off option. The manual also includes certification information for the Safe-Off option.
Kinetix 6000 Multi-axis Servo Drive User Manual, publication 2094-UM001	Provides detailed information on installing, connecting, configuring, and troubleshooting a Kinetix 6000 drive. The manual also includes specifications and dimensions.
Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002	Provides detailed information on the safety requirements, as well as connector and wiring diagrams for the Safe-off feature.
Kinetix Motion Control Selection Guide, publication GMC-SG001	Provides features, specifications, and dimensions for selecting Kinetix Motion Control servo drives, motors, actuators, and accessory components.
Ultra3000 Digital Servo Drives Installation Manual, publication 2098-IN003	Provides information on installing and wiring for the Ultra3000 Digital Servo Drives.
Ultra3000 Digital Servo Drives Integration Manual, publication 2098-IN005	Provides power-up procedures, system integration, and troubleshooting tables for the Ultra3000 Digital Servo Drives.
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control, publication SGI-1.1	Describes important differences between solid state control and hard-wired electromechanical devices.

You can view or download publications at: http://literature.rockwellautomation.com. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Safety Concept

Introduction

This chapter describes the safety performance level concept and how the MSR57P Speed Monitoring Safety Relay can meet the requirements for SIL CL3, PL(e), or CAT 4 applications.

Topic	Page
Safety Certification	13
Functional Proof Tests	16
PFD and PFH Definitions	16
PFD and PFH Data	17
Safe State	17
Safety Reaction Time	18
Considerations for Safety Ratings	18
Contact Information if Device Failure Occurs	22

Safety Certification

The MSR57P Speed Monitoring Safety Relay is certified for use in safety applications up to and including SIL CL3 according to IEC 61508 and EN 62061, Performance Level PL(e) and CAT 4 according to ISO 13849-1. Safety requirements are based on the standards current at the time of certification.

The TÜV Rheinland group has approved the MSR57P Speed Monitoring Safety Relay for use in safety-related applications where the de-energized state is considered to be the safe state. All of the examples related to I/O included in this manual are based on achieving de-energization as the safe state for typical Machine Safety and Emergency Shutdown (ESD) systems.

Important Safety Considerations

The system user is responsible for:

- the set-up, safety rating, and validation of any sensors or actuators connected to the system.
- completing a system-level risk assessment and reassessing the system any time a change is made.
- certification of the system to the desired safety performance level.
- project management and proof testing.
- programming the application software and the device configurations in accordance with the information in this manual.
- access control to the system, including password handling.
- analyzing all configuration settings and choosing the proper setting to achieve the required safety rating.

IMPORTANT When applying Functional Safety, restrict access to qualified, authorized personnel who are trained and experienced.

ATTENTION

When designing your system, consider how personnel will exit the machine if the door locks while they are in the machine. Additional safeguarding devices may be required for your specific application.

ATTENTION

A HIM module may be used to configure and monitor the MSR57P speed monitoring safety relay. However, the stop button on the HIM does not have safety integrity and must not be used to execute a safe stop.

The stop button setting is not maintained through a power cycle. Do not use the stop button in conjunction with an Automatic Reset configuration. Unintended motion could result.

Safety Category 4 Performance Definition

To achieve Safety Category 4 according to ISO 13849-1:2006, the safety-related parts have to be designed such that:

- the safety-related parts of machine control systems and/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled, and combined in accordance with relevant standards so that they can withstand expected conditions.
- basic safety principles shall be applied.
- a single fault in any of its parts does not lead to a loss of safety function.
- a single fault is detected at or before the next demand of the safety function, or, if this detection is not possible, then an accumulation of faults shall not lead to a loss of the safety function.
- the average diagnostic coverage of the safety-related parts of the control system shall be high, including the accumulation of faults.
- the mean time to dangerous failure of each of the redundant channels shall be high.
- measures against common cause failure shall be applied.

Stop Category Definitions

The selection of a stop category for each stop function must be determined by a risk assessment.

- Stop Category 0 is achieved with immediate removal of power to the actuator, resulting in an uncontrolled coast to stop. Safe Torque Off accomplishes a Stop Category 0 stop.
- Stop Category 1 is achieved with power available to the machine actuators to achieve the stop. Power is removed from the actuators when the stop is achieved.
- Stop Category 2 is a controlled stop with power available to the machine actuators. The stop is followed by a holding position under power.

IMPORTANT When designing the machine application, timing and distance should be considered for a coast to stop (Stop Category 0 or Safe Torque Off). For more information regarding stop categories, refer to EN 60204-1.

Performance Level and Safety Integrity Level (SIL) 3

For safety-related control systems, Performance Level (PL), according to ISO 13849-1, and SIL levels, according to IEC 61508 and EN 62061, include a rating of the system's ability to perform its safety functions. All of the safety-related components of the control system must be included in both a risk assessment and the determination of the achieved levels.

Refer to the ISO 13849-1, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

See Chapter 10, Safety Configuration and Verification, for more information on the requirements for configuration and verification of a safety-related system containing the MSR57P Speed Monitoring Safety Relay.

Functional Proof Tests

The functional safety standards require that functional proof tests be performed on the equipment used in the system. Proof tests are performed at user-defined intervals and are dependent upon PFD and PFH values.

IMPORTANT Your specific application determines the time frame for the proof test interval.

PFD and PFH Definitions

Safety-related systems can be classified as operating in either a Low Demand mode, or in a High Demand/Continuous mode.

- Low Demand mode: where the frequency of demands for operation made on a safety-related system is no greater than one per year or no greater than twice the proof-test frequency.
- High Demand/Continuous mode: where the frequency of demands for operation made on a safety-related system is greater than once per year or greater than twice the proof test interval.

The SIL value for a low demand safety-related system is directly related to order-of-magnitude ranges of its average probability of failure to satisfactorily perform its safety function on demand or, simply, average probability of failure on demand (PFD). The SIL value for a High Demand/continuous mode safety-related system is directly related to the probability of a dangerous failure occurring per hour (PFH).

PFD and PFH Data

These PFD and PFH calculations are based on the equations from Part6 of EN 61508 and show worst-case values.

This table provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

PFD and PFH for 20-year Proof Test Interval

Attribute	Pulse Test ON		Pulse Test OFF(1)
	Single Encoder	Dual Encoder	
PFD	1.23E - 04	5.93E-04	25.9E-04
PFH	7.04E-09	3.38E-09	14.8E-09
SFF	99.3%	99.2%	97.9%

(1) Pulse testing for outputs is configured using the following parameters: P71 [MP Out Mode], P72 [SS Out Mode], P73 [SLS Out Mode], P74 [Door Out Mode]. If you disable pulse-testing on any of these outputs, the achievable SIL, Category, and PL ratings of your entire MSR57P safety system are reduced. See Outputs beginning on page 63 for more information.

Safe State

The Safe State encompasses all operation that occurs outside of the other monitoring and stopping behavior defined as part of the speed monitoring safety relay. In addition, configuration takes place in the Safe State. While the relay is in the Safe State, all safety control outputs, except the Door Control (DC_Out) output, are in their safe state (de-energized). The Door Control (DC_Out) output will be in either the locked state or in the de-energized state depending upon the condition that resulted in the safe state.

The diagnostic Fault_Status output may be on in the safe state.

When you cycle power, the relay enters the Safe State for self-testing. If the self-tests pass and there is a valid configuration, the relay remains in the Safe State until a successful request for safe speed monitoring occurs.

If a Safe State Fault is detected, the relay goes to the Safe State. This includes faults related to integrity of hardware or firmware.

For more information on faults, see Chapter 12, Troubleshoot the MSR57P Relay.

Safety Reaction Time

The safety reaction time is the amount of time from a safety-related event as input to the system until the system is in the Safe State.

The safety reaction time from an input signal condition that triggers a safe stop, to the initiation of the configured Safe Stop Type, is 20 ms (maximum).

The safety reaction time from an overspeed event that triggers a safe stop, to the actual initiation of the configured Safe Stop Type, is equal to the value of the P24 [OverSpd Response] parameter.

For more information on overspeed response time, see Overspeed Response Time on page 75.

Considerations for Safety Ratings

The achievable safety rating of an application using the MSR57 relay is dependent upon many factors, including the encoder setup, drive options, output pulse testing, and the type of motor.

When using two independent encoders to monitor motion and when installed in a manner to avoid any common cause dangerous failure, the MSR57P relay can be used in applications up to and including SIL CL3, PL(e), and CAT 4.

When using a drive with the Safe-Off option and one external contactor, or when using two external contactors, the MSR57P relay can be used in applications up to and including SIL CL3, PL(e), and CAT 4.

IMPORTANT Some of the diagnostics performed on the encoder signals require motion to detect faults. You must make sure that motion occurs at least once every six months.

Output Pulse Test Considerations

If the pulse testing of *any* safety output is disabled, the maximum safety rating will be up to and including SIL CL2, PL(d), and CAT 3 for any safety chain incorporating *any input or output* of the MSR57P relay.

IMPORTANT Setting any of the P71 [MP_Out Mode], P72 [SS_Out Mode], P73 [SLS_Out Mode], or P74 [DC_Out Mode] parameters to 1 = No Pulse Test disables internal diagnostics as well as external diagnostics required to achieve higher safety ratings.

You must exercise the SS_In input at least once every six months.

You may need to disable pulse-testing if the connected device does not support OSSD inputs. Refer to the product documentation for your connected device.

Considerations for Single-encoder Applications

When configured correctly, the MSR57P relay performs these diagnostics on the encoder:

- $Sin^2 + Cos^2$ diagnostic.
- detection of open or short-circuit.
- encoder supply voltage monitoring.
- detection of illegal quadrature transitions of the sine and cosine signals.

A safety rating up to and including SIL CL3, PL(e), and CAT 4 can be achieved in a single-encoder application with these requirements:

- The motor is a permanent magnet (PM) brushless AC motor.
- The motor controller must be configured as a closed-loop application with field-oriented control using the single-encoder for commutation.
- The motor-to-encoder coupling is designed to exclude shaft slippage as a dangerous failure mechanism.
- The MSR57P relay is configured for Sin/Cos encoder type.

- The encoder is of the Sin/Cos type and is suitable for the desired safety rating of the application.

  An encoder that is suitable for SIL CL3 applications must:

  – use independent Sine/Cosine signals.
  – be incapable of producing simulated signals when under an error condition.
  – use simple or discreet circuitry with no complex or programmable internal devices.

- The controller is **not** configured for auto transition to encoderless commutation in the event of encoder failure.

- The motor controller must use the same encoder signals as MSR57P relay.

- Encoder voltage monitoring in MSR57P relay must be enabled.

- The system design of the motor/encoder-to-load coupling excludes shaft slippage and breakage as a dangerous failure mechanism.

Single-encoder with Kinetix Drive

A safety rating up to and including SIL CL3, PL(e), and CAT 4 can be achieved in an MSR57P relay single-encoder application when the relay is used in conjunction with a properly-configured Kinetix Servo Drive with Safe-Off and any motor/encoder combination that meets the single-encoder application requirements on page 19.

Single-encoder with PowerFlex Drive

A safety rating up to and including SIL CL3, PL(e), and CAT 4 can be achieved in an MSR57P relay single-encoder application when the relay is used in conjunction with a properly-configured PowerFlex 700S or PowerFlex 755 drive and any motor/encoder combination that meets the single-encoder application requirements on page 19.

For example, to properly configure a PowerFlex 700S drive to meet the single-encoder application requirements listed on page 19, make these parameter settings.

Parameter Number	Parameter Name	Required Drive Parameter Setting	Addresses Single-encoder Requirement
P485	Motor Ctrl Mode	2 = Pmag Motor	The motor controller must be configured as a closed-loop application with field-oriented control using the single-encoder for commutation.
P222	Mtr Fdbk Sel Pri	5 = FB Opt Port0	
P153, bit 16	Control Options	OFF = Auto Tach Sw	The controller is *not* configured for auto transition to encoderless commutation in the event of encoder failure.

You must make sure that a Sin/Cos feedback option is installed in the drive. The drive must be commissioned according to the normal startup procedure for proper operation in your system.

The MSR57P is suitable for SIL CL3, Cat 4 applications when connected to drives which also support Cat 4 applications. Some applications may require an external contactor to meet Cat 4 requirements. Refer to your drive manual for details on safety requirements.

Refer to the PowerFlex 700S Phase II Drive User Manual, publication 20D-UM006 for detailed information on installing, configuring, and operating a PowerFlex 700S drive.

Understanding Commutation

Permanent magnet (PM), brushless AC motors, like those listed above, are a class of synchronous motor that depend on electronic brushless commutation to generate torque and motion. In PM brushless motors, an electromagnetic field is created by the permanent magnets on the rotor. A rotating magnetic field is created by a number of electromagnets commutated electronically with insulated-gate bipolar transistors (IGBT's) at the right speed, order, and times. Movement of the electromagnetic field is achieved by switching the currents in the coils of the stator winding. This process is called commutation. Interaction of the two electromagnetic fields produces magnetic force or torque.

Excessive noise, broken encoder wires, and loss of the encoder power supply are factors that can affect commutation while the motor is running. To prevent the motor from spinning, these conditions can be detected by the drive with the use of safety monitoring circuits.

Contact Information if Device Failure Occurs

If you experience a failure with any safety-certified device, contact your local Rockwell Automation distributor. With this contact, you can:

- return the device to Rockwell Automation so the failure is appropriately logged for the catalog number affected and a record is made of the failure.
- request a failure analysis (if necessary) to determine the probable cause of the failure.

About the MSR57P Speed Monitoring Safety Relay

Introduction

This chapter describes the features of the MSR57P Speed Monitoring Safety Relay.

Topic	Page
Safety Functions	23
Hardware Features	26
Configuration	27

Safety Functions

The MSR57P Speed Monitoring Safety Relay features five inputs, three sets of safety outputs, and one bipolar safety output. Each of the inputs supports a specific safety function.

- Safe Stop (SS)
- Safe Limited Speed Monitoring (SLS)
- Door Monitoring (DM)
- Enabling Switch Monitoring (ESM)
- Lock Monitoring (LM)

An additional reset input provides for reset and monitoring of the safety circuit.

The relay can be used in single-axis or multi-axis applications, and the relay is configurable as a master or slave based on its location in the system.

Safety Modes

The relay can be configured to operate in one of 11 user-selectable safety modes, based on combinations of the safety functions listed on the previous page. The relay monitors motion for Safe Stop in every mode except Disabled.

Safety Mode	Page
Disabled – In this mode, all safety functions are disabled.	24
Safe Stop – The relay activates the configured Safe Stop Type upon deactivation of the Safe Stop input or the occurrence of a Stop Category Fault.	89
Safe Stop with Door Monitoring – In addition to monitoring for Safe Stop, the relay monitors the status of the door.	102
Safe Limited Speed – In addition to monitoring for Safe Stop, the relay monitors the feedback velocity and compares it to a configurable Safe Speed Limit. If the velocity exceeds the limit, the relay initiates the configured Safe Stop Type.	105
Safe Limited Speed with Door Monitoring – In addition to monitoring for Safe Stop and Safe Limited Speed, the relay monitors the status of the door.	110
Safe Limited Speed with Enabling Switch Control – In addition to monitoring for Safe Stop and Safe Limited Speed, the relay monitors the status of the Enabling Switch input.	112
Safe Limited Speed with Door Monitor and Enabling Switch – In addition to monitoring for Safe Stop and Safe Limited Speed, the relay monitors the status of the door and the Enabling Switch input.	115
Safe Limited Speed (status only) – In addition to monitoring for Safe Stop, the relay monitors the feedback velocity and compares it to a configurable Safe Speed Limit. If the velocity exceeds the limit, the system status is made available as a safe output intended for a safety programmable logic controller. No stopping action takes place.	119
Slave, Safe Stop – The relay performs the same functions as Safe Stop. However, it regards the Door Monitor input as a Door Control output from an upstream axis, and performs a logical AND with its internal Door Control signal to form the cascaded Door Control output.	125
Slave, Safe Limited Speed – The relay performs the same functions as Safe Limited Speed mode. However, it regards the Door Monitor input as a Door Control output from an upstream axis, and performs a logical AND with its internal Door Control signal to form the cascaded Door Control output.	132
Slave, Safe Limited Speed (status only) – The relay performs the same functions as Safe Limited Speed Status Only mode. However, it regards the Door Monitor input as a Door Control output from an upstream axis, and performs a logical AND with its internal Door Control signal to form the cascaded Door Control output.	135

Disabled Mode

In Disabled mode, all safety functions are disabled. Input, output, or speed monitoring diagnostics do not take place and all outputs are in their safe state.

Lock Monitoring

Lock monitoring helps prevent access to the hazard during motion. In many applications, it is not sufficient for the machine to initiate a stop command once the door has been opened because a high inertia machine may take a long time to stop. Preventing access to the hazard until a safe speed has been detected may be the safest condition. The lock monitoring feature is used to verify the operation of the door locking mechanism.

Lock monitoring can be enabled on single units or on the first unit in a multi-axis system. If the Lock Monitor input (LM_In) indicates that the door is unlocked when the Door Control output (DC_Out) is in the locked state, or if the Lock Monitor input indicates locked when the Door Monitor input (DM_In) transitions from closed to open, the configured Safe Stop Type is initiated.

Safe Maximum Speed, Safe Maximum Acceleration, and Safe Direction Monitoring

Three additional safety functions, Safe Maximum Speed (SMS), Safe Maximum Acceleration (SMA) and Safe Direction Monitoring (SDM), operate independent of the other modes, relying on the Safe Stop function. When you configure the relay for Safe Maximum Speed, the feedback velocity is monitored and compared against a user-configurable limit. If the measured velocity is greater than or equal to the limit, the configured Safe Stop type is executed.

When Safe Acceleration Monitoring is enabled, the relay monitors the acceleration rate and compares it to a configured Safe Maximum Acceleration Limit. If acceleration is detected as greater than or equal to the Safe Maximum Acceleration Limit, an Acceleration Fault occurs. If an Acceleration Fault is detected while the relay is actively monitoring motion, the configured Safe Stop type is initiated.

Safe Direction Monitoring is also activated via device configuration. The relay monitors the feedback direction and executes the configured Safe Stop type when motion in the illegal direction is detected.

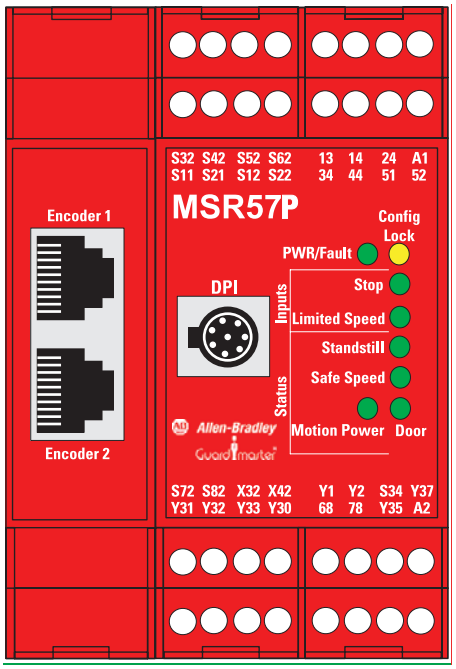
See Chapter 9, Safe Maximum Speed and Direction Monitoring, for detailed information on these functions.

Hardware Features

The MSR57P relay features five dual-channel inputs, three sets of sourcing safety outputs, and one bipolar safety output. You can configure dual-channel inputs to accept contact devices with two normally closed contacts, or one normally closed and one normally open contact. They can also be configured for single channel operation.

IMPORTANT Single-channel operation does not meet SIL CL3, PL(e), Cat 4 safety integrity.

These inputs also support output signal switching devices (OSSD). Each output has integral pulse-test checking circuitry. Two RJ-45 connectors support encoder inputs. The MSR57P relay features status indicators and status data for troubleshooting.



Configuration

Configure the MSR57P relay by setting the configuration parameters using a HIM module (catalog number 20-HIM-A3). You can also use DriveExplorer software, version 5.02 or later, or DriveExecutive software[(1)], version 4.01 or later. All of these configuration tools let you save the configuration and download it to another MSR57P relay. Only DriveExecutive software lets you edit the configuration offline.

When the relay configuration is complete, it can be safety-locked to prevent unauthorized changes to the safety configuration. If you set a password to protect the safety configuration, you must enter the password before you can lock or unlock the configuration.

If you are using a HIM to configure the relay, see Appendix C for information on connecting a HIM and setting parameters with the keypad. If you are using software to configure the relay, see Appendix D for information on connecting to a personal computer and using the software.

(1) RSLinx software, version 2.50.00 or later, is required for DriveExecutive software.

Installation and Wiring

Introduction

This chapter provides details on connecting devices and wiring the MSR57P relay.

Topic	Page
Environment and Enclosure	31
General Safety Information	30
Dimensions	31
Spacing Requirements	32
Mount the MSR57P Relay	32
Power Supply Requirements	32
Removable Terminal Blocks	33
Circuit Diagram	33
Terminal Connections	34
Compatible Encoders	35
Connect an Encoder	36
Encoder Cable Specifications	42
Feedback Cable Connections for Kinetix 2000, Kinetix 6000, Kinetix 7000 and Ultra3000 Drives	42
Feedback Connections for PowerFlex 70 Drives	52
Feedback Connections for PowerFlex 700S Drives	55
Connect a Configuration Device	55

ATTENTION

This device is intended to be part of the safety-related control system of a machine. Before installation, a risk assessment should be performed to determine whether the specifications of this device are suitable for all foreseeable operational and environmental characteristics for the system to which it is to be installed.

General Safety Information

WARNING

Use this product for its intended applications.
This equipment must not be used for unintended applications, nor in ways that do not conform to appropriate safety standards and good practices. The safety functions may not operate properly, or at all, if this equipment is not used for the intended purposes.

Use within specified operating limits.
This product and the equipment on which it is installed, persons handling the product and the equipment, and/or the immediate environment can be harmed if this equipment is operated outside the specified limits of any of its technical specifications.

Installation and operation must be performed only by qualified technical personnel.
This equipment is to be installed, started up, and operated only by technical personnel who have been trained and understand:

- the products covered by this publication.
- directives, regulations, and good practices relating to machine safety.
- instrumentation and automation components, equipment, and systems.
- industrial electrical practices.

Up-to-date user documentation must be readily accessible by technical personnel.
The latest version of user documentation that includes instructions for installation, operation, and maintenance of this product must be readily available to personnel involved in any of these tasks.

Identify hazardous areas and dangerous operating modes before using the product.
Machine safety applications make it necessary for hazardous areas and dangerous operating modes to be carefully identified, and adequate measures taken to be sure that failure or tampering does not allow automated equipment to be of risk to personnel.

Observe electrical safety regulations and good practices.
Electrical safety regulations stipulated by the appropriate technical authorities must be observed.

Do not use the product if it is damaged or diminished in any way.
Carefully inspect the product before it is installed, or reinstalled. If, at any time, the condition of the product is observed to be diminished in any way so that there is even the slightest possibility of incorrect functioning, you should assume that safe operation is no longer possible, and the equipment should be removed from the system immediately so that unintentional operation is impossible. Examples of such conditions are:

- visible damage to the equipment.
- loss of electrical functions.
- exposure to temperatures higher than the specified operating limit.
- visible indication of burning.
- physical damage due to impact or excessive mechanical shock.

Observe all electrical safety regulations stipulated by the appropriate technical authorities.

ATTENTION

Make sure that electrical power supply to the MSR57P relay is switched off before making or removing any electrical connections.

Environment and Enclosure

IMPORTANT This product must be installed inside protected control panels or cabinets appropriate for the environmental conditions of the industrial location. The protection class of the panel or cabinet should be IP54 or higher.

See the specifications in Appendix A.

Considerations for Reducing Noise

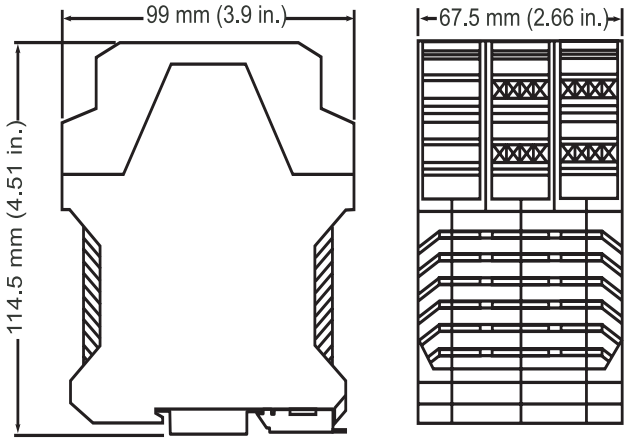
To reduce the affects of electromagnetic interference (EMI), follow these guidelines when connecting your system:

- Keep wire lengths as short as possible.
- Route signal cables away from motor and power wiring.
- Ground all equipment, following the manufacturers instructions.

Additional noise reduction techniques may be necessary.

Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001 for more information.

Dimensions



Spacing Requirements

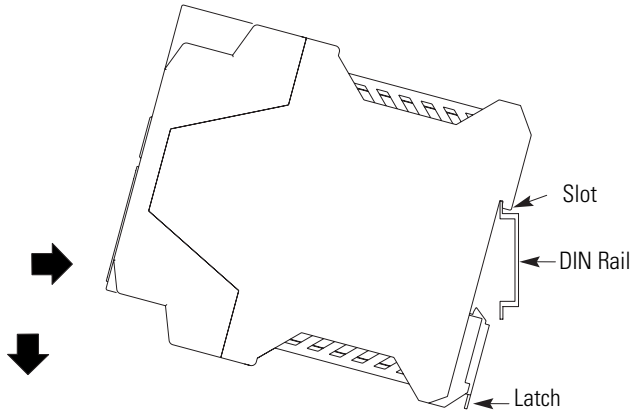
Adequate air space must be provided around the system (module cluster). Minimum recommended clearances:

- 15 mm (0.6 in.) above
- 15 mm (0.6 in.) below
- 2…3 mm (0.08…0.12 in.) between modules at ambient temperatures higher than 40 °C (104 °F).

Mount the MSR57P Relay

Follow these steps to mount the MSR57P relay to an EN50022 -35 x 7.5 DIN rail.

1. Hook the top slot over the DIN rail.
2. Snap the bottom of the relay into position while pressing the relay down against the top of the rail.



3. Attach end plates on each end of the DIN rail.

To remove the relay from the DIN rail, use a flathead screwdriver to pull down the latch and lift the relay from the rail.

Power Supply Requirements

The external power supply must conform to the Directive 2006/95/EC Low Voltage, by applying the requirements of EN61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests and one of the following:

- EN60950- SELV (Safety Extra Low Voltage)
- EN60204 - PELV (Protective Extra Low Voltage)
- IEC 60536 Safety Class III (SELV or PELV)
- UL 508 Limited Voltage Circuit

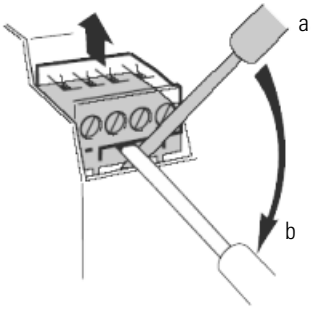
To meet EN60204 - PELV, 24V DC + 10% - 20% has to be supplied by a power supply that complies with IEC/EN60204 and IEC/EN 61558-1.

Such a power supply meets the electrical safety requirements and maintains minimum power of 19.2V DC during 20 ms even in the event of voltage dips.

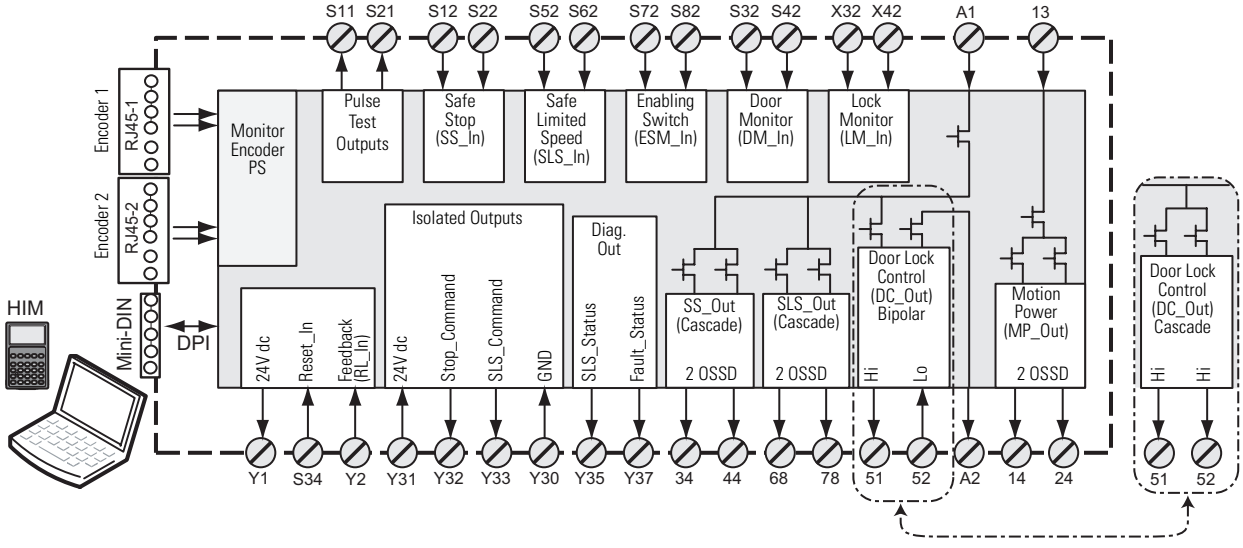
For planning information, refer to the guidelines in Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1.

Removable Terminal Blocks

To remove an upper terminal block, insert a screwdriver into the slot (a) as shown and push down (b) to disconnect the terminal block. For the lower terminal blocks, reverse the direction of the action.



Circuit Diagram



Terminal Connections

Tighten all terminal screws firmly and recheck them after all connections have been made. Recommended terminal screw torque is 0.6…0.8 Nm (5…7 lb-in).

Terminal	Function
A1	+24V dc, user supply(1)
A2	Common, user supply
S11, S21	Test_Out_0, Test_Out_1, pulse test output for Safe Stop (SS), Safe Limited Speed (SLS), Enabling Switch Monitor (ESM), Door Monitor (DM), and Lock Monitor (LM)
S12, S22	SS_In_Ch0, SS_In_Ch1, Safe Stop (SS) dual-channel input
S72, S82	ESM_In_Ch0, ESM_In_Ch1, Enabling Switch Monitoring (ESM) dual-channel input
S52, S62	SLS_In_Ch0, SLS_In_Ch1, Safe Limited Speed (SLS) dual-channel input
S32, S42	DM_In_Ch0, DM_In_Ch1, Door Monitoring (DM) dual-channel input
X32, X42	LM_In_Ch0, LM_In_Ch1, Lock Monitor (LM) dual-channel input, solenoid position
Y1	24V dc output; RL Feed for reset (S34) and for feedback (Y2)
S34	Reset_In
Y2	RL_In, feedback input
Y35	SLS_Status output
Y37	Fault_Status output
13	Supply power for SS safety output 14 and Motion Power (MP) safety output 24
14, 24	MP_Out_Ch0, MP_Out_Ch1, Motion Power (MP) outputs
68, 78	SLS_Out_Ch0, SLS_Out_Ch1, Safe Limited Speed (SLS) outputs
51	DC_Out_Ch0 (High Side), Door Control output (door switch solenoid, bipolar or 2 Channel Source)
52	DC_Out_Ch1 (Low Side), Door Control output (door switch solenoid, bipolar or 2 Channel Source)
34, 44	SS_Out_Ch0, SS_Out_Ch1, Safe Stop (SS) outputs
Y31	24V dc power for isolated outputs
Y32	Stop_Command, isolated output
Y33	SLS_Command, isolated output
Y30	GND for isolated outputs

(1) The MSR57P may be powered when +24V power is removed from terminal A1 and a sourcing safety output is shorted to +24V. If A1 power must be removed, also remove any power that could be shorted to a safety sourcing output.

Compatible Encoders

These feedback devices are supported.

Supported Feedback Devices

Cat. No. and Description		Additional Resources
Sin/Cos Encoders[1]	842HR-*x*J*xxx*15FWY*x*	Refer to the Bulletin 842HR Sin/Cosine Encoders product profile, publication 842HR-PP001, for more information on these encoders.
Incremental Encoders[1]	845T-*xx*12*xxx-x* and 845T-*xx*13*xxx-x* 845T-*xx*42*xxx* and 845T-*xx*43*xxx-x* 845T-*xx*52*xxx* and 845T-*xx*53*xxx-x*	Refer to the Sensors Reference Catalog, publication C115, for catalog number, dimensions, and specifications for Bulletin 845T and 845H Incremental Encoders.
	845H-SJ*xxx*4*xx*Y*xx*	
Rotary Motors	1326AB-B*xxxx*-M2L/-S2L	Refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001, for more information on these motors.
	HPK-Series Asynchronous Servo Motor	
	MP-Series Motors with embedded Sin/Cos or incremental encoders	
	TL-Series (TLY-A*xxxxx*-H) Motors with incremental encoders	
	Any motor with SHS-170 Stegmann encoder	Refer to the product documentation for your specific motor to determine the encoder type.
	Any motor with SCS-60 Stegmann encoder	
	Any motor with SRS-60 Stegmann encoder	
	Any motor with SRM-60 Stegmann encoder	
	Any motor with SCS-Kit 101 Stegmann encoder	
	Any motor with SRS660 Stegmann encoder	
Linear Actuators	MP-Series Integrated Linear Stages	Refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001, for more information on these actuators.

(1) Maximum cable length for encoders is 90 m (295 ft).

Connect an Encoder

Use twisted-pair, individually-shielded cable to connect encoders and drives. Refer to your encoder or drive manual for proper cable type and maximum length.

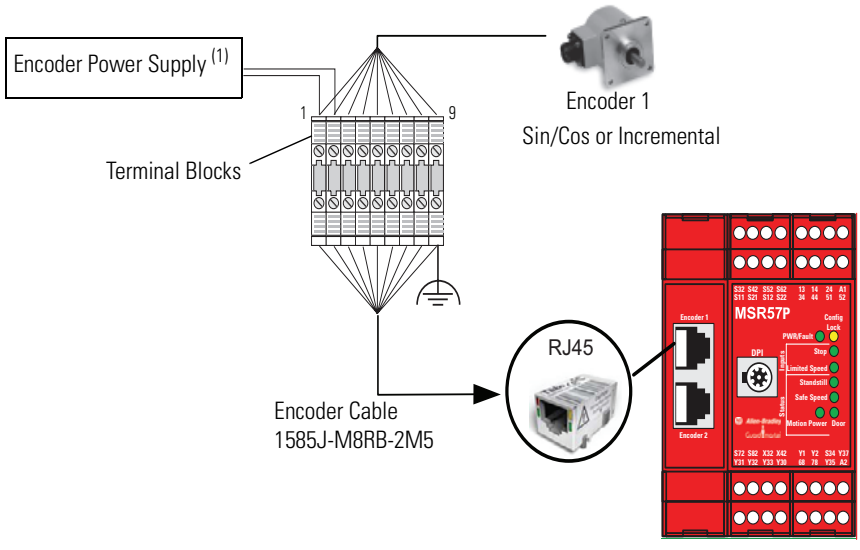
IMPORTANT The drive or encoder and the MSR57P power supply reference must be the same.

IMPORTANT The MSR57P relay has an internal resistance of 600Ω on each of the encoder signals to achieve an equivalent load resistance of 100Ω if used with a drive that has 120Ω internal terminating resistors. Your encoder may require that the equivalent load resistance be 100Ω or greater. Refer to your encoder user manual to make sure the equivalent termination resistance does not exceed the encoder signal loading specification.

ATTENTION Do not use external terminating resistors with PowerFlex or Kinetix drives. Doing so may cause permanent damage to the drive.

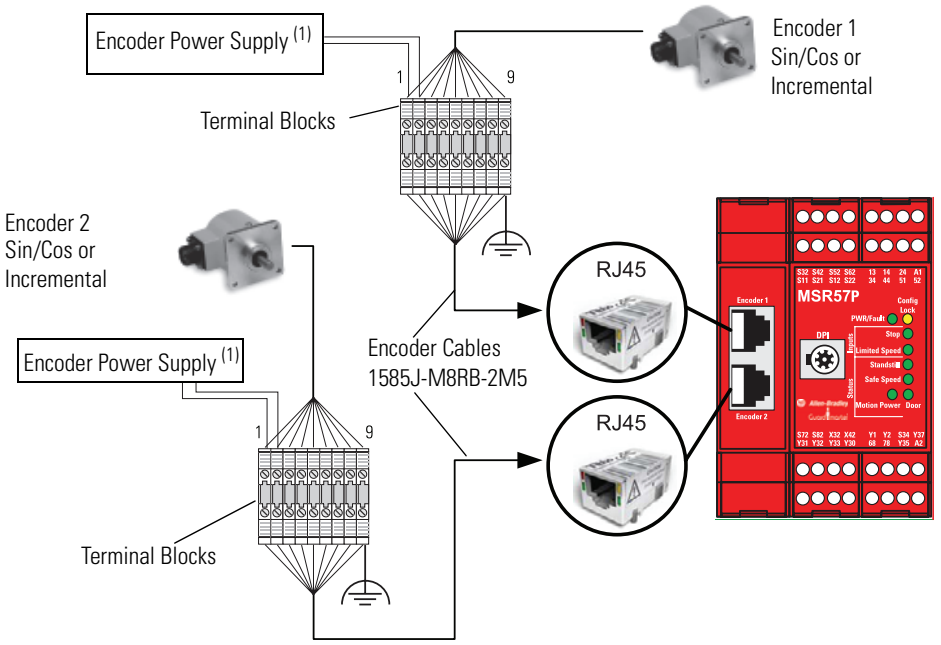
The following illustrations show simple examples of how to connect an MSR57P relay with an encoder, with or without a drive.

Single Encoder without a Drive



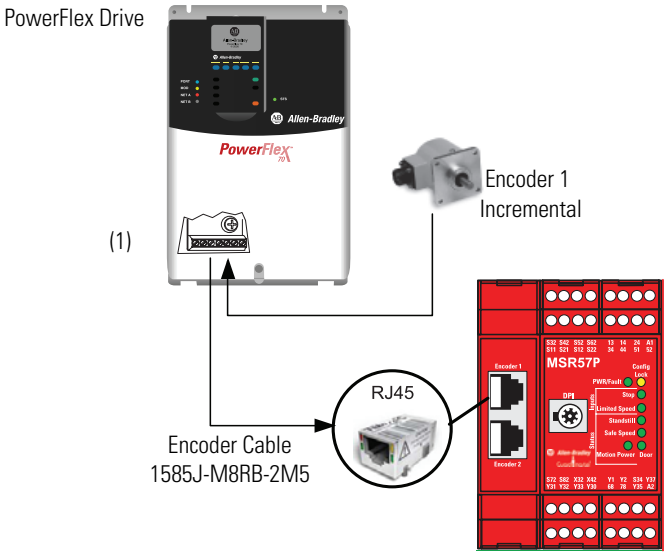
(1) Refer to your encoder specifications to determine power supply requirements (5V, 9V, 12V, or 24V).

Two Encoders without a Drive



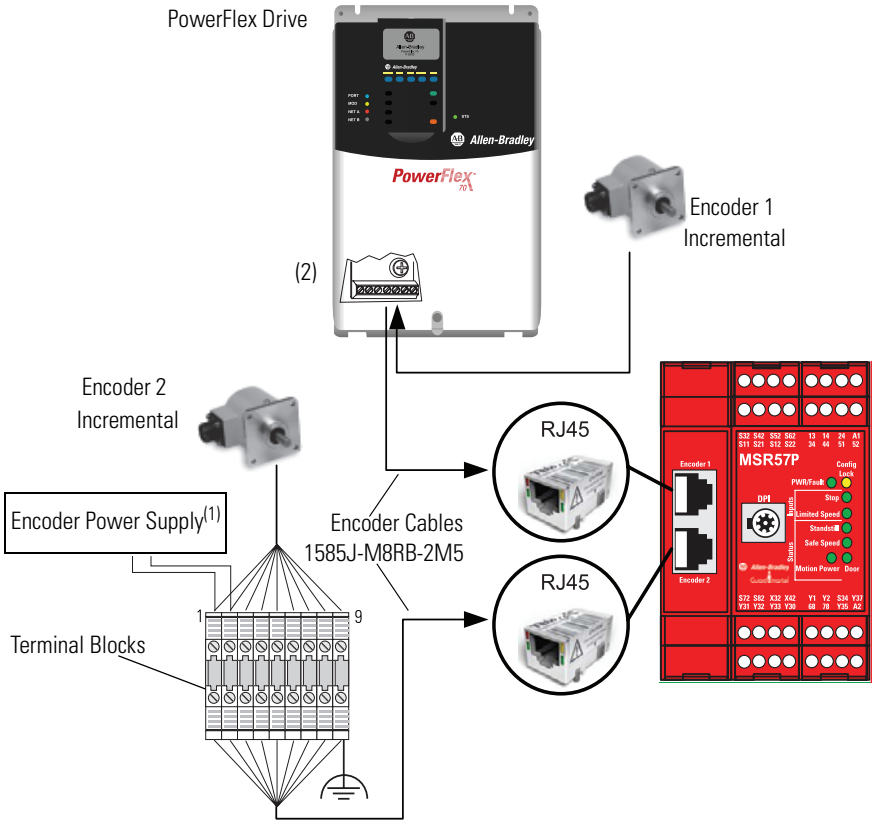
(1) Refer to your encoder specifications to determine power supply requirements (5V, 9V, 12V, or 24V).

Single Encoder with PowerFlex Drive



(1) Terminate shield to functional earth at drive end. See page 53.
Encoder power (5V or 12V) sourced from the drive.

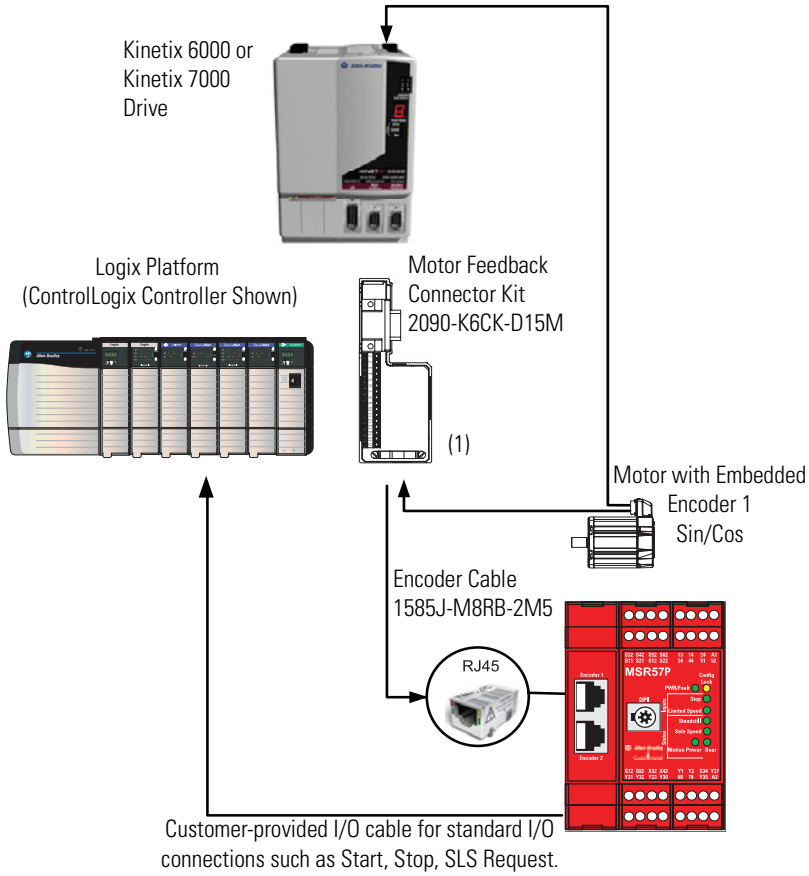
Two Encoders with PowerFlex Drive



(1) Refer to your encoder specifications to determine power supply requirements (5V, 9V, 12V, or 24V).

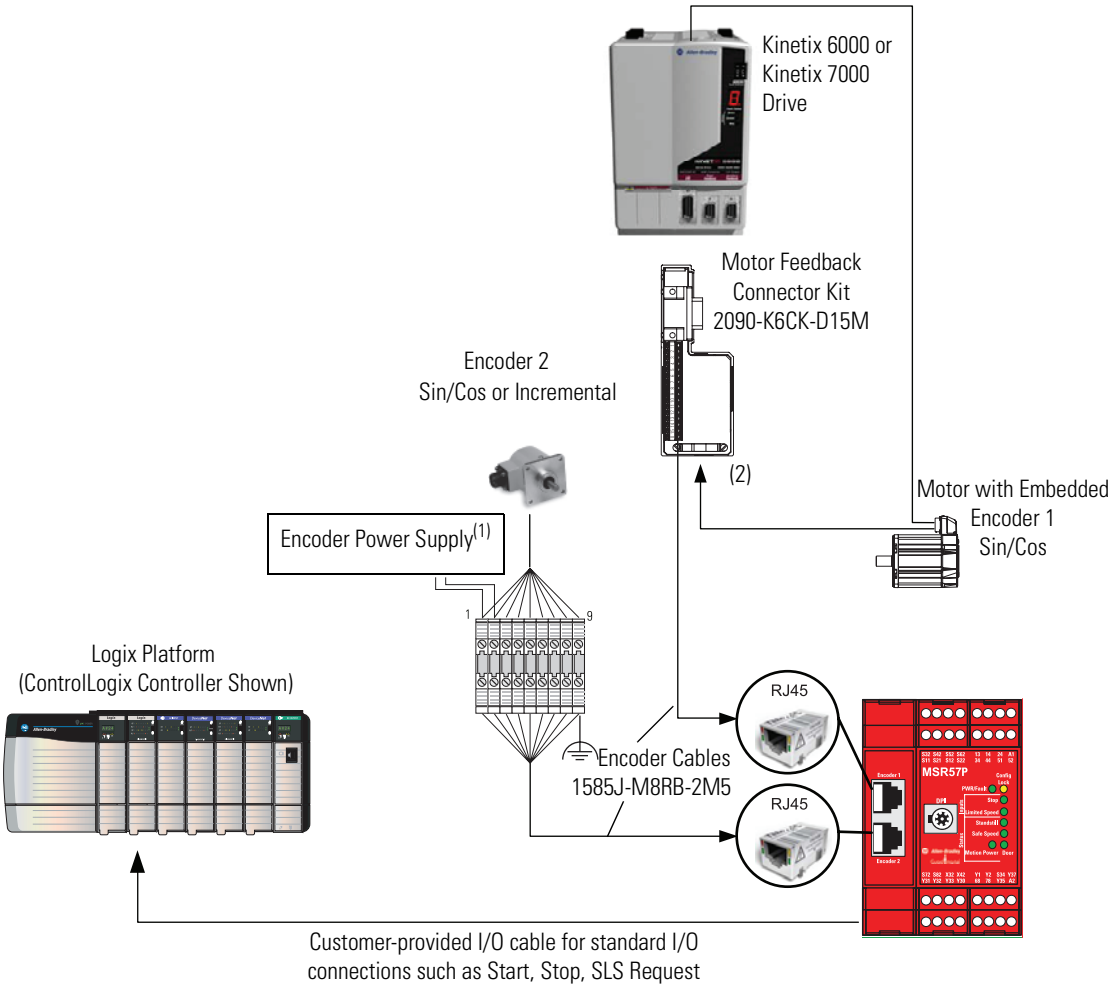
(2) Terminate shield to functional earth at drive end. See page 53.
Encoder power (5V or 12V) sourced from the drive.

Single Encoder with a Kinetix 6000 or Kinetix 7000 Drive



(1) Terminate shield to functional earth at drive end. See page 52.

Two Encoders with a Kinetix 6000 or Kinetix 7000 Drive

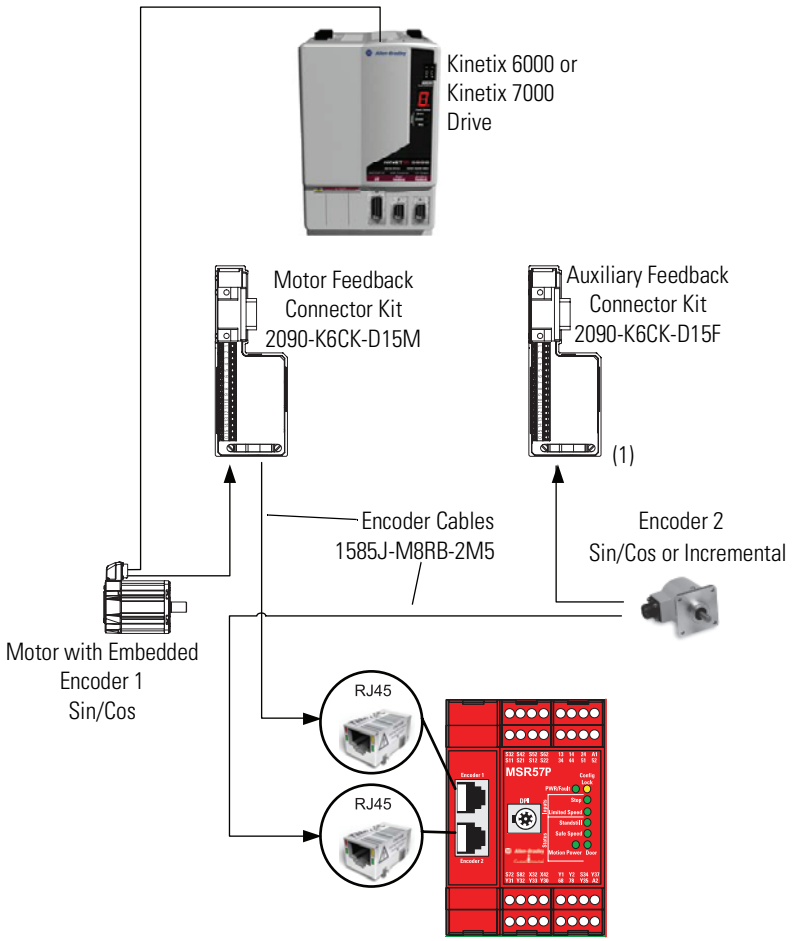


(1) Refer to your encoder specifications to determine power supply requirements (5V or 9V).

(2) Terminate shield to functional earth at drive end. See page 52.

In this example, only the feedback from Encoder 1 is monitored by the drive.

Monitoring Feedback from Two Encoders with a Kinetix 6000 or Kinetix 7000 Drive



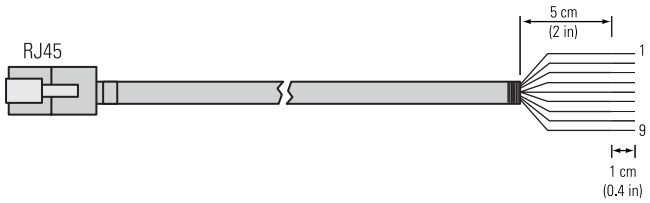
(1) Terminate shield to functional earth at drive end. See page 52.

In this example, feedback from both encoders is monitored by the drive.

Encoder Cable Specifications

To connect the MSR57P, use the 1585J-M8RB-2M5 cable available from Rockwell Automation.

1585J-M8RB-2M5 Cable



2.5 m Cable Catalog Number	Connection to MSR57P Relay	Connection to Encoder	Connection to Drive or Power Supply
1585J-M8RB-2M5	RJ45	Flying leads	Flying leads

1585J-M8RB-2M5 Flying-Lead Wires

Pin Number	Wire Color	Signal
1	White/Orange	GND
2	Orange	Vcc
3	White/Blue	A1-/SIN1-REF
4	Blue	A1+/SIN1+
5	Green	NC
6	White/Brown	B1-/COS1-REF
7	White/Green	NC
8	Brown	B1+/COS1+
9	Bare	Shield (case)(1)

(1) Terminate encoder shield to functional earth at the drive.

Feedback Cable Connections for Kinetix 2000, Kinetix 6000, Kinetix 7000 and Ultra3000 Drives

To connect your MSR57P relay to a Kinetix drive, review the connector options and compatible cable and motor types listed in the following tables.

Connector Options for Connecting Motor and Auxiliary Feedback

Connection Option	Connector Kit Catalog Number	Description	Using this Type of Cable
Low-profile connectors for Kinetix 6000 and Kinetix 7000 Drives	2090-K6CK-D15M	Motor feedback connector kit	Refer to the table of Motor Feedback Cables for Specific Motor/Feedback Combinations.
	2090-UXBK-D15*xx*	15-pin panel-mounted breakout board kit	
	2090-K6CK-D15F	Auxiliary feedback connector kit	User-supplied flying-lead cable.
Low-profile connectors for Kinetix 2000 Drives	2090-K2CK-D15M	Motor feedback connector kit	Refer to the table of Motor Feedback Cables for Specific Motor/Feedback Combinations.
	2090-K2CK-COMBO	Motor, auxiliary, and I/O feedback connector kit	
	2090-UXBK-D15*xx*	15-pin panel-mounted breakout board kit	
Flying lead cable at Ultra3000 drive end with one of these three kits.	2090-UXBB-DM15	15-pin drive-mounted breakout board	Refer to the table of Motor Feedback Cables for Specific Motor/Feedback Combinations.
	2090-UXBK-D15*xx*	15-pin panel-mounted breakout board kit	
	2090-UXCK-D15	15-pin (high-density D-shell) drive connector kit	

Motor Feedback Cables for Specific Motor/Feedback Combinations

Compatible Drives[1]				Motor Series	Feedback Type	Flying-Lead Feedback Cable	Pinout
Ultra3000	**Kinetix 2000**	**Kinetix 6000**	**Kinetix 7000**				
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A*xxxx*-M/S	Multi-turn high-resolution absolute or single-turn high-resolution encoder	2090-XX*x*FMP-S*xx*[2] [3] or 2090-XXNFMF-S*xx* (non-flex)[4] or 2090-CFBM4DF-CDAF*xx* (continuous-flex)[4]	Page 44
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPL-B*xxxx*-M/S			
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	1326AB-B*xxxx*-M2L 1326AB-B*xxxx*-S2L			
—	—	—	2099-BM*xx*-S	MPL-B5*xxx*-M/S, MPL-B6*xxx*-M/S, MPL-B8*xxx*-M/S, MPL-B9*xxx*-M/S			
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A3*xxx*-H MPL-A4*xxx*-H MPL-A45*xxx*-H	Incremental encoder		
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A*xxxx*-V/E MPF-A*xxxx*-M/S MPS-A*xxxx*-M/S	Multi-turn high-resolution absolute or single-turn high-resolution encoder	2090-XXNFMF-S*xx* (non-flex)[4] or 2090-CFBM4DF-CDAF*xx* (continuous-flex)[4]	Page 47 Page 49
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPL-B*xxxx*-V/E MPF-B*xxxx*-M/S MPS-B*xxxx*-M/S			
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPL-A15*xxx*-H MPL-A2*xxx*-H	Incremental encoder		
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPL-B15*xxx*-H MPL-B2*xxx*-H			
—	—	—	2099-BM*xx*-S	HPK-series	High-resolution encoder		
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	TLY-A*xxxx*-H	Incremental encoder	2090-CFBM6DF-CBAA*xx*	Page 50
2098-DSD-*xxx*	2093-AC05-MP*x* 2093-AM*xx*	2094-AC*xx*-M*xx*-S 2094-AM*xx*-S	—	MPAS-A*xxxx*-V/A	Multi-turn high-resolution absolute or single-turn high-resolution encoder	2090-XXNFMF-S*xx* (non-flex)[4] or 2090-CFBM4DF-CDAF*xx* (continuous-flex)[4]	Page 47 Page 49
2098-DSD-HV*xxx*	—	2094-BC*xx*-M*xx*-S 2094-BM*xx*-S	—	MPAS-B*xxxx*-V/A			

(1) Refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001 for detailed information on the compatibility of specific drive and motor combinations.
(2) For Bulletin MPL motors equipped with bayonet-style connectors.
(3) These cables are available as non-flex (catalog number 2090-XXNFMP-S*xx*) and continuous-flex (catalog number 2090-XXTFMP-S*xx*).
(4) For Bulletin MPL motors equipped with DIN-style connectors.

Flying-lead Feedback Cable Pin-outs

Motors Using 2090-XXxFMP-Sxx Feedback Cable

MPL-B*xxx*-M/-S, MPL-A5*xxx*-M/-S, and 1326AB-B*xxx*-M2L/-S2L Motors

Drive Side					MSR57P Relay Side		
Motor Connector Pin[1]		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
A	Black	Sine+	1	—>	4	Blue	A1+/SIN1+
B	White/Black	Sine-	2	—>	3	White/Blue	A1-/SIN1-REF
C	Red	Cos+	3	—>	8	Brown	B1+/COS1+
D	White/Red	Cos-	4	—>	6	White/Brown	B1-/COS1-REF
E	Green	Data+	5		NC		
F	White/Green	Data-	10		NC		
K	Gray	EPWR_5V	14		NC		
L	White/Gray	ECOM	6	—>	1	White/Orange	GND
N	Orange	EPWR_9V	7	—>	2	Orange	Vcc
R		TS+	11		NC		
T		S1	12		NC		
U		S2	13		NC		
V		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g[2]	Bare	Shield (case)

(1) Bayonet-style connector

(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See the diagram on page 52.

MPL-A3*xxx*-M/-S, MPL-A4*xxx*-M/-S, and MPL-A45*xxx*-M/-S Motors

Drive Side					MSR57P Relay Side		
Motor Connector Pin(1)		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
A	Black	Sine+	1	—>	4	Blue	A1+/SIN1+
B	White/Black	Sine-	2	—>	3	White/Blue	A1-/SIN1-REF
C	Red	Cos+	3	—>	8	Brown	B1+/COS1+
D	White/Red	Cos-	4	—>	6	White/Brown	B1-/COS1-REF
E	Green	Data+	5		NC		
F	White/Green	Data-	10		NC		
K	Gray	EPWR_5V	14	—>	2	Orange	Vcc
L	White/Gray	ECOM	6	—>	1	White/Orange	GND
N	Orange	EPWR_9V	7		NC		
R		TS+	11		NC		
T		S1	12		NC		
U		S2	13		NC		
V		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(2)	Bare	Shield (case)

(1) Bayonet-style connector

(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See the diagram on page 52.

MPL-A3*xxx*-H, MPL-A4*xxx*-H, and MPL-A45*xxx*-H Motors

Drive Side					MSR57P Relay Side		
Motor Connector Pin[1]		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
A	Black	AM+	1	—>	4	Blue	A1+/SIN1+
B	White/Black	AM-	2	—>	3	White/Blue	A1-/SIN1-REF
C	Red	BM+	3	—>	8	Brown	B1+/COS1+
D	White/Red	BM-	4	—>	6	White/Brown	B1-/COS1-REF
E	Green	IM+	5		NC		
F	White/Green	IM-	10		NC		
K	Gray	EPWR_5V	14	—>	2	Orange	Vcc
L	White/Gray	ECOM	6	—>	1	White/Orange	GND
N	Orange	EPWR_9V	7		NC		
R		TS+	11		NC		
T		S1	12		NC		
U		S2	13		NC		
V		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					9[2]	Bare	Shield (case)

(1) ITT Cannon connector

(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See the diagram on page 52.

Motors Using 2090-XXNFMF-Sxx or 2090-CFBM4DF-CDAFxx Feedback Cable

MPL-B15*xxx*-V/-E, MPL-B2*xxx*-V/-E, MPF/MPS-B*xxx*-M/-S, MPF-A5*xx*-M/-S Motors and MPAS-B*xxxx*-V*xx*S*x*A Linear Stages

Drive Side					MSR57P Relay Side		
Motor Connector Pin (1)		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
1	Black	Sine+	1	—>	4	Blue	A1+/SIN1+
2	White/Black	Sine-	2	—>	3	White/Blue	A1-/SIN1-REF
3	Red	Cos+	3	—>	8	Brown	B1+/COS1+
4	White/Red	Cos-	4	—>	6	White/Brown	B1-/COS1-REF
5	Green	Data+	5		NC		
6	White/Green	Data-	10		NC		
9	Gray	EPWR_5V	14		NC		
10	White/Gray	ECOM	6	—>	1	White/Orange	GND
11	Orange	EPWR_9V	7	—>	2	Orange	Vcc
13		TS+	11		NC		
15		S1	12		NC		
16		S2	13		NC		
17		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(2)	Bare	Shield (case)

(1) DIN Connector

(2) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See the diagram on page 52.

MPL-A15*xxx*-V/-E, MPL-A2*xxx*-V/-E, MPF/MPS-A3*xx*-M/-S, MPF/MPS-A4*xx*-M/-S, MPF/MPS-A45*xx*-M/-S, MPS-A5*xx*-M/-S Motors and MPAS-A*xxxx*-V*xx*S*x*A Linear Stages

Drive Side					MSR57P Relay Side		
Motor Connector Pin (DIN Connector)		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
1	Black	Sine+	1	—>	4	Blue	A1+/SIN1+
2	White/Black	Sine-	2	—>	3	White/Blue	A1-/SIN1-REF
3	Red	Cos+	3	—>	8	Brown	B1+/COS1+
4	White/Red	Cos-	4	—>	6	White/Brown	B1-/COS1-REF
5	Green	Data+	5		NC		
6	White/Green	Data-	10		NC		
9	Gray	EPWR_5V	14	—>	2	Orange	Vcc
10	White/Gray	ECOM	6	—>	1	White/Orange	GND
11	Orange	EPWR_9V	7		NC		
13		TS+	11		NC		
15		S1	12		NC		
16		S2	13		NC		
17		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(1)	Bare	Shield (case)

(1) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See the diagram on page 52.

MPL-A15*xxx*-H, MPL-A2*xxx*-H, MPL-B15*xxx*-H, MPL-B2*xxx*-H Motors and MPAS-A/B*xxxx*-ALM*x*2C Linear Stages

Drive Side					MSR57P Relay Side		
Motor Connector Pin (DIN Connector)		Signal	Drive MF Connector Pin		1585J-M8RB-2M5 Cable		
					Pin	Wire Color	Signal
1	Black	AM+	1	—>	4	Blue	A1+/SIN1+
2	White/Black	AM-	2	—>	3	White/Blue	A1-/SIN1-REF
3	Red	BM+	3	—>	8	Brown	B1+/COS1+
4	White/Red	BM-	4	—>	6	White/Brown	B1-/COS1-REF
5	Green	IM+	5		NC		
6	White/Green	IM-	10		NC		
9	Gray	EPWR_5V	14	—>	2	Orange	Vcc
10	White/Gray	ECOM	6	—>	1	White/Orange	GND
11	Orange	EPWR_9V	7		NC		
13		TS+	11		NC		
15		S1	12		NC		
16		S2	13		NC		
17		S3	8		NC		
					5	Green	NC
					7	White/Green	NC
					g(1)	Bare	Shield (case)

(1) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See the diagram on page 52.

Motors Using 2090-CFBM6DF-CBAAxx Cables

TLY-A*xxxx*-H Motors

Drive Side					MSR57P Relay Side		
					1585J-M8RB-2M5 Cable		
Motor Connector Pin		Signal	Drive CN2 Connector Pin		Pin	Wire Color	Signal
9	Black	AM+	1	—>	4	Blue	A1+/SIN1+
10	White/Black	AM-	2	—>	3	White/Blue	A1-/SIN1-REF
11	Red	BM+	3	—>	8	Brown	B1+/COS1+
12	White/Red	BM-	4	—>	6	White/Brown	B1-/COS1-REF
13	Green	IM+	5		NC		
14	White/Green	IM-	10		NC		
22	Gray	EPWR_5V	14	—>	2	Orange	Vcc
23	White/Gray	ECOM	6	—>	1	White/Orange	GND
15		S1	12		NC		
17		S2	13		NC		
19		S3	8		NC		
24		Shield		—>	1	White/Orange	GND
					NC		
					NC		
					NC		
					5	Green	NC
					7	White/Green	NC
					9[1]	Bare	Shield (case)

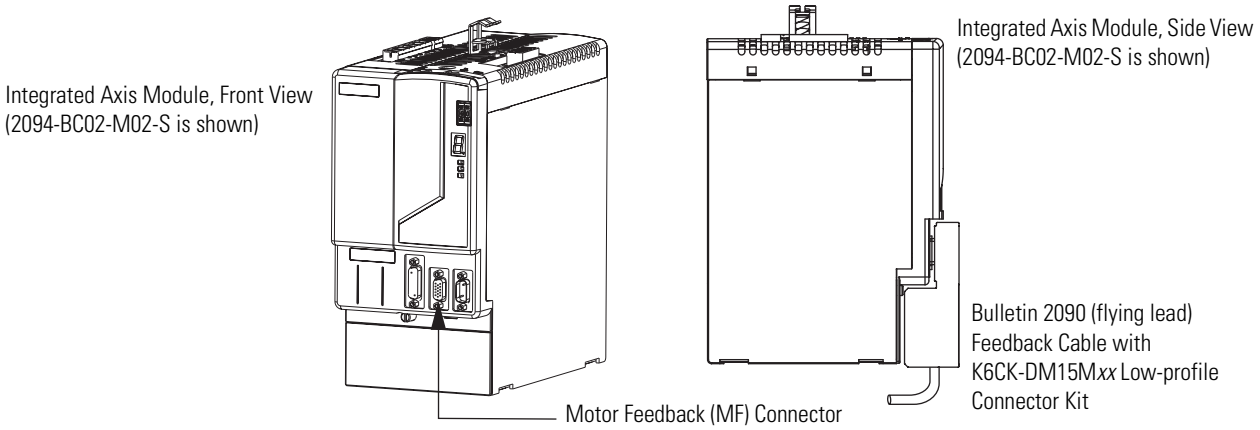
(1) Make sure you ground the shield properly to the low profile connector along with the feedback cable. See the diagram on page 52.

Wiring Low-profile Connector Kits

Low-profile connector kits (2090-K6CK-D*xxx*) are suitable for motor feedback (MF), auxiliary feedback (AF), and I/O (IOD) connections on any Kinetix 6000 IAM or AM module or on a Kinetix 7000 Drive when used with an MSR57P relay.

Use Low-profile connector kit 2090-K2CK-D15M or 2090-K2CK-COMBO for Kinetix 2000 drives.

Kinetix 6000 Integrated Axis Module/Axis Module (MF connector) Example

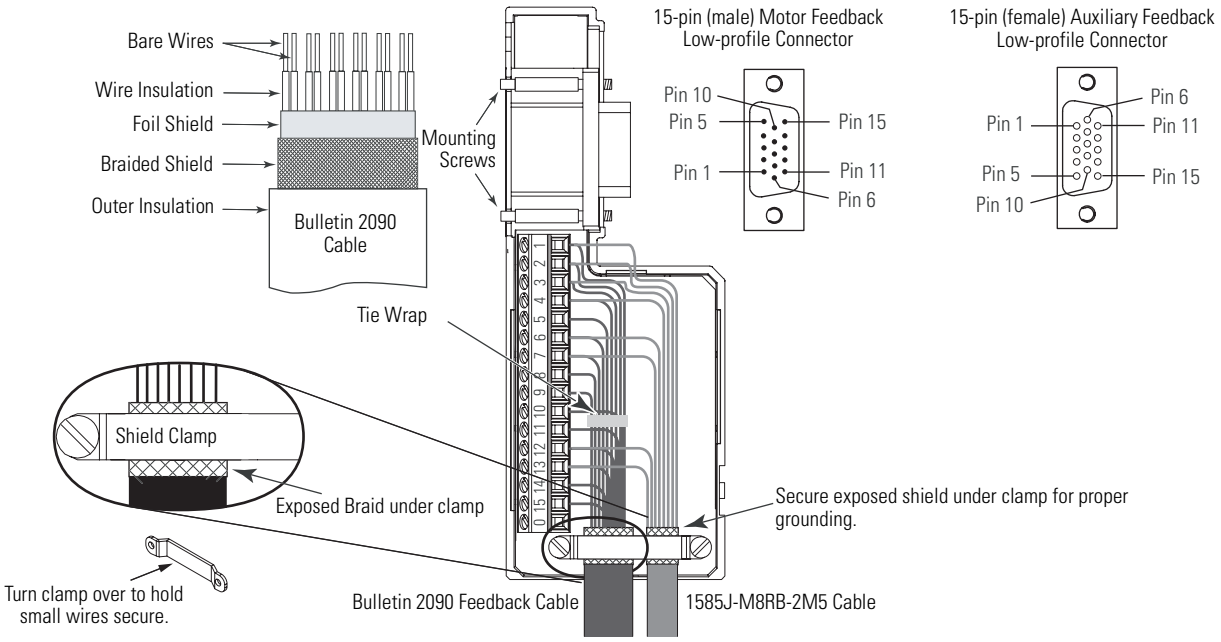


IMPORTANT Tightening the mounting screws is essential to ensure shield integrity of the low-profile connector covers with the drive feedback connector D-shells. Use 0.4 Nm (3.5 lb-in) torque.

For detailed information on connections and important wiring requirements regarding Kinetix 2000, Kinetix 6000, Kinetix 7000, and Ultra3000 drives, please refer to these publications:

- Kinetix 2000 Multi-axis Servo Drive User Manual, publication 2093-UM001.
- Kinetix 6000 Multi-axis Servo Drive User Manual, publication 2094-UM001.
- Kinetix 7000 High Power Servo Drive User Manual, publication 2099-UM001.
- Ultra3000 Digital Servo Drives Integration Manual, publication 2098-IN005.
- Ultra3000 Digital Servo Drives Installation Manual, publication 2098-IN003.
- System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Wiring (15-Pin) Flying-lead Feedback Cable Connections

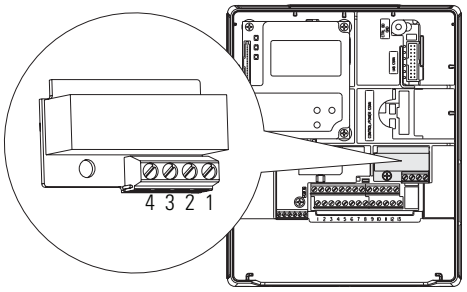


Feedback Connections for PowerFlex 70 Drives

IMPORTANT For detailed information in installing and connecting PowerFlex 70 drives, including important wiring requirements, refer to these publications:

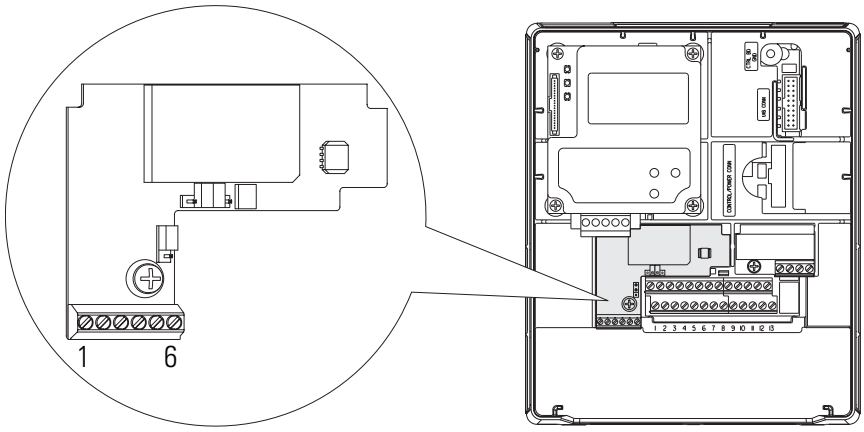
- PowerFlex 70 User Manual, publication 20A-UM001.
- DriveGuard Safe-Off Option (Series B) for PowerFlex 40P and 70 AC Drives User Manual, publication PFLEX-UM003.
- Wiring and Grounding Guidelines for AC Drives, publication DRIVES-IN001.

Safe Off Board Terminal Block (Enhanced Control Only)



No.	Signal	Description
1	Monitor - N.C.	Normally closed contacts for monitoring relay status. Maximum Resistive Load: 250V ac / 30V dc / 50 VA / 60 W Maximum Inductive Load: 250V ac / 30V dc / 25 VA / 30 W
2	Common - N.C.	
3	+24V dc	Connections for user supplied power to energize coil.
4	24V Common	

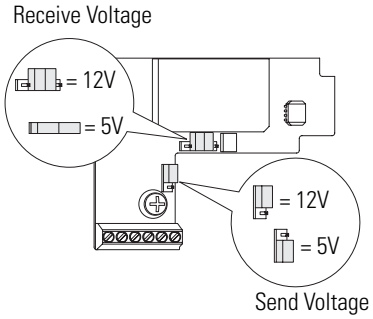
Encoder Interface Terminal Block (Enhanced Control Only)



PowerFlex 70 Side			MSR57P Relay Side		
Terminal	**Signal**		**Pin**	**Color**	**Signal**
1	5-12V Power(1)	—>	2	Orange	Vcc
2	Power Return	—>	1	White/Orange	GND
3	Encoder B (NOT)	—>	6	White/Brown	B1-/COS1-
4	Encoder B	—>	8	Brown	B1+/COS1+
5	Encoder A (NOT)	—>	3	White/Blue	A1-/SIN1-
6	Encoder A	—>	4	Blue	A1+/SIN1+
CASE	Shield	—>	9	Bare	Shield

(1) Jumper selectable +5/12V is available on 20A-ENC-1 Encoder Boards.

Jumper Settings



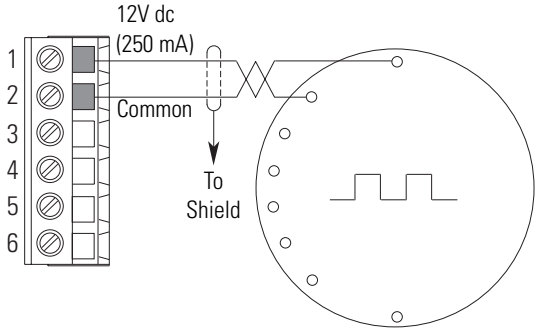
Set the jumper according to your encoder specifications.

Encoder Wiring Examples

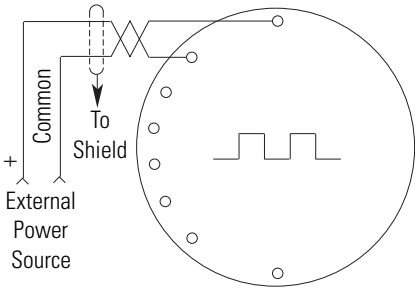
These illustrations show examples of how to connect encoder power and encoder signals.

Encoder Power

Internal (Drive)

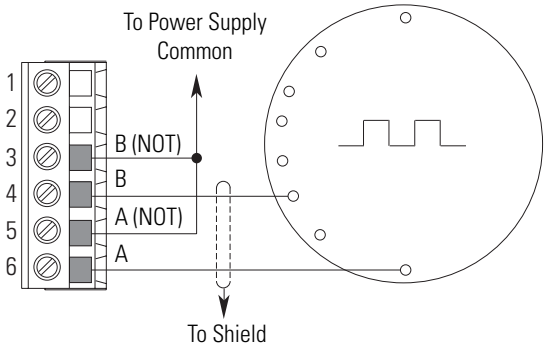


External Source

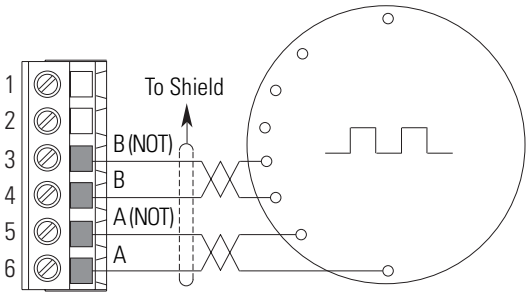


Encoder Signal

Single-ended, Dual-channel

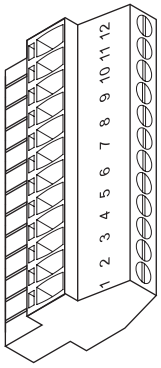


Differential, Dual-channel



Feedback Connections for PowerFlex 700S Drives

Use the terminal connection information in the table to connect your MSR57P relay to a PowerFlex 700S drive.



PowerFlex 700S Side				MSR57P Relay Side		
	Terminal	**Signal**		**Pin**	**Color**	**Signal**
	12	Power Common	—>	1	White/Orange	GND
	11	POWER	—>	2	Orange	Vcc
	10	REFSIN	—>	3	White/Blue	A1-/SIN1-
	9	+SIN	—>	4	Blue	A1+/SIN1+
	8	REFCOS	—>	6	White/Brown	B1-/COS1-
	7	+COS	—>	8	Brown	B1+/COS1+
	6	Shield	—>	9	Bare	Shield
	5	Shield				
	4	NC		NC		
	3	NC		NC		
	2	DATA+ (RS 485)		NC		
	1	DATA- (RS 485)		NC		

IMPORTANT For detailed information in installing and connecting PowerFlex 700S drives, including important wiring requirements, refer to the PowerFlex 700S Phase II Drive User Manual, publication 20D-UM006.

Connect a Configuration Device

If you are using a HIM to configure the relay, see Appendix C for information on connecting a HIM and setting parameters with the keypad.

If you are using software to configure the relay, see Appendix D for information on connecting to a personal computer and using the software.

Speed Monitoring I/O Signals

Introduction

This chapter describes the input and output signals of the speed monitoring relay.

Topic	Page
Inputs	57
Outputs	63

Inputs

The MSR57P relay has five inputs capable of safety-certified dual-channel support. Each dual-channel input supports a specific safety function of the MSR57P relay: Safe Stop, Safe Limited Speed, Door Monitoring, Enabling Switch Monitoring, and Lock Monitoring.

All five inputs are electrically identical and rely on the same pair of pulse test outputs, Test_Out_0 (S11) and Test_Out_1 (S21), when not using the OSSD configuration.

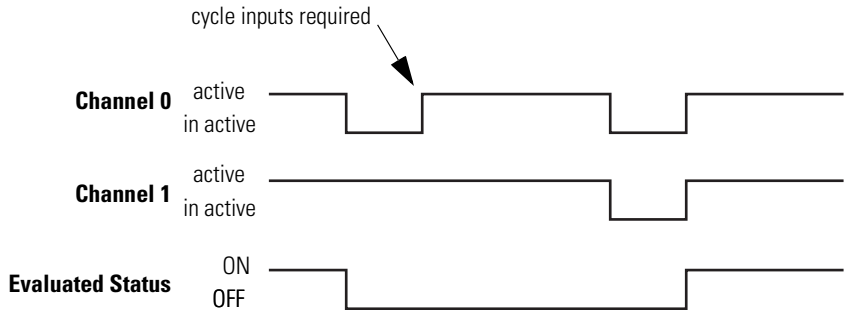
The inputs can be configured for one of the following settings:

- 0 = Not used
- 1 = Dual-channel equivalent (2NC)
- 2 = Dual-channel equivalent 3 s (2NC 3s)
- 3 = Dual-channel complementary (1NC + 1NO)
- 4 = Dual-channel complementary 3 s (1NC + 1NO 3s)
- 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s)
- 6 = Single channel (1NC).

IMPORTANT Single-channel configuration (1NC) is not SIL CL3, PL(e), Cat 4.

When configured for dual-channel operation, the consistency between the two channels is evaluated. For dual-channel equivalent configurations, the active state for both channel 0 and channel 1 is ON. For dual-channel complementary configurations, the active state for channel 0 is ON and the active state for channel 1 is OFF. Any time both channels are not active, the input pair is evaluated as OFF.

When both channels are active, if one channel's input terminal transitions from active to inactive and back to active, while the other channel's input terminal remains active, both channel must go inactive at the same time before the evaluated status may return to ON. This condition is called 'cycle inputs required'.



If inputs are configured with the following dual channel settings, an Input fault occurs if the inputs are discrepant for longer than 3 seconds or if a 'cycle inputs required' condition exists lor longer than 3 seconds.

- 2 = Dual-channel equivalent 3 s (2NC 3s)
- 4 = Dual-channel complementary 3 s (1NC + 1NO 3s)
- 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s)

If inputs are configured with one of the following dual channel settings, which have no limit on the length of time that inputs can be discrepant, an Input fault will not occur for any discrepant condition or for any 'cycle inputs required' condition.

- 1 = Dual-channel equivalent (2NC)
- 3 = Dual-channel complementary (1NC + 1NO)

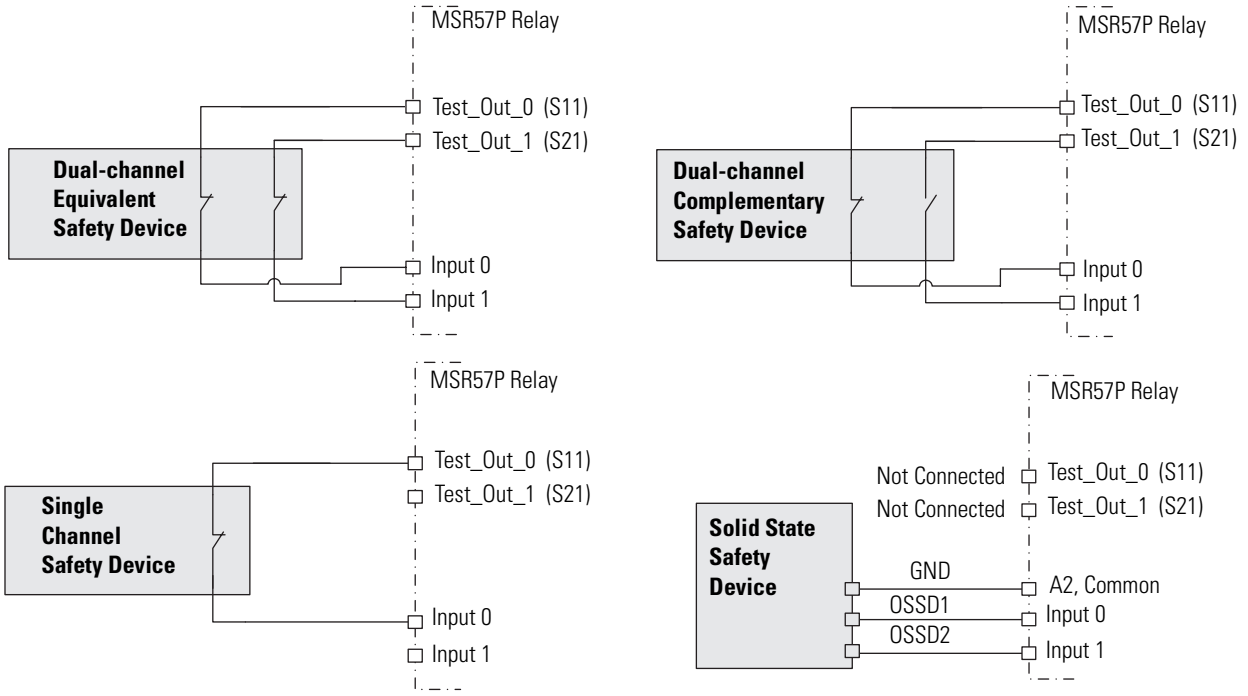
For all input settings except Dual-channel SS equivalent 3 s (2 OSSD 3s), if one or two channels are connected to a 24V DC source other than terminals S11 and S21, a fault occurs.

I/O faults are Stop Category Faults, which initiate the configured Safe Stop Type. I/O faults are latched until the relay is successfully reset.

For more information on I/O faults, see Chapter 12, Troubleshoot the MSR57P Relay.

When using a dual-channel complementary (1NC + 1NO) device, the normally-open input must be connected to the second input, as shown in the illustration. For example, if the door is open when the input is ON, the normally-open contact must be the second input (Input 1).

Safety Input Wiring Examples



IMPORTANT Cross-wiring of Test Outputs to Inputs is not allowed. For example, do not connect Test_Out_0 to Input 1 or Test_Out_1 to Input 0.

Function	Terminals				
	Safe Stop (SS_In)	**Safe Limited Speed (SLS_In)**	**Door Monitoring (DM_In)**	**Enabling Switch Monitoring (ESM_In)**	**Lock Monitoring (LM_In)**
Input 0 = Channel 0	S12	S52	S32	S72	X32
Input 1 = Channel 1	S22	S62	S42	S82	X42

Short-circuits of the input loop to ground or 24V will be detected. For dual-channel inputs, cross loops will also be detected.

Safe Stop Input (SS_In)

The SS_In input is intended for connection to an E-Stop device.

The SS_In input must be active to initiate Safe Stop monitoring. If the SS_In input is being monitored, a transition from ON to OFF (closed to open) is used to request the configured Safe Stop Type.

In a cascaded configuration, the SS_In input is connected to the Safe Stop (SS_Out) output of an upstream MSR57P relay.

Safe Limited Speed Input (SLS_In)

The SLS_In input is used to connect to a switch whose OFF state requests Safe Limited Speed monitoring.

If Safe Limited Speed monitoring is configured, the SLS_In input is monitored from the time of a successful Safe Stop Reset or Safe Limited Speed Reset, until the time that the configured Safe Stop Type is initiated or the Safe State is entered.

If the SLS_In input is being monitored, the OFF state is used to request the Safe Limited Speed monitoring functionality of the relay.

In a cascaded configuration, the SLS_In input is connected to the Safe Stop (SS_Out) output of an upstream MSR57P relay.

Door Monitor Input (DM_In)

This input monitors the status of the door to indicate if it is open or closed. The DM_In input can be connected to a non-guardlocking switch if the door does not need to be locked. The door status is monitored by the first unit in multi-axis systems.

The DM_In input is intended for connection to a guardlocking switch when the speed monitoring relay is configured as a master device with door monitoring. When the MSR57P relay is configured as a slave in a cascaded system, its DM_In input is connected to the Door Control output (DC_Out) of the upstream MSR57P relay.

Enabling Switch Monitor Input (ESM_In)

The ESM_In input is intended to be connected to an enabling switch. The speed monitoring relay uses the ESM_In input as a safety enable only, not for control. The ESM_In inputs function and monitoring is performed by the first unit in multi-axis systems.

The ESM_In input ON state is used to enable motion under mode-specific conditions in the Safety Limited Speed with Enabling Switch (Lim Speed ES) and Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring (LimSpd DM ES) modes.

See Safe Limited Speed with Enabling Switch Monitoring Mode on page 112 and Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring Mode on page 115 for the conditions that must be true to start monitoring the ESM_In input.

If the ESM_In input is OFF while it is being monitored, an ESM Monitoring Fault (Stop Category Fault) occurs and the relay initiates the configured Safe Stop Type.

See Chapter 12, Troubleshoot the MSR57P Relay, for information on faults and how to recover from them.

Lock Monitor Input (LM_In)

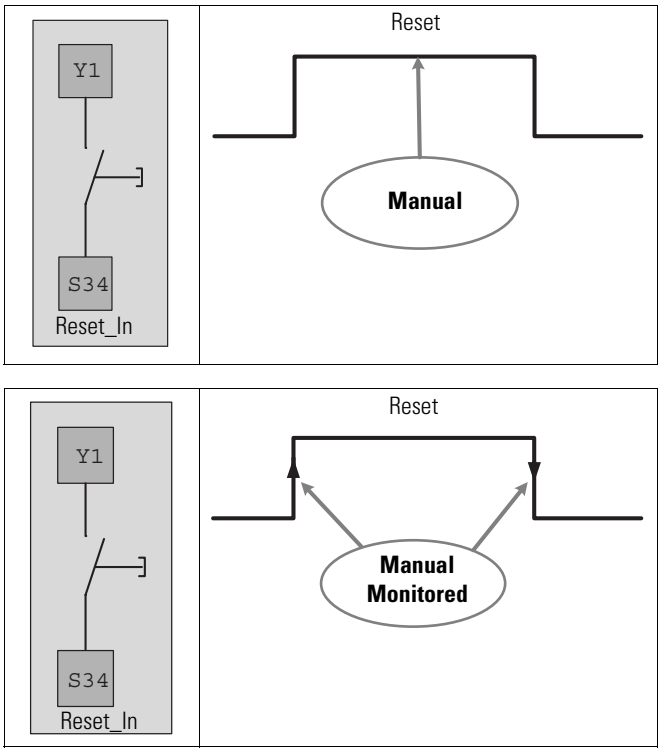
The LM_In input verifies that the guardlocking solenoid switch is locked. It is intended to confirm the door control function.

The LM_In input is monitored by the first unit in multi-axis systems.

Reset Input (Reset_In)

The Reset input is for reset and monitoring of the safety circuit. The reset input can be configured for automatic, manual, or manual monitored reset types.

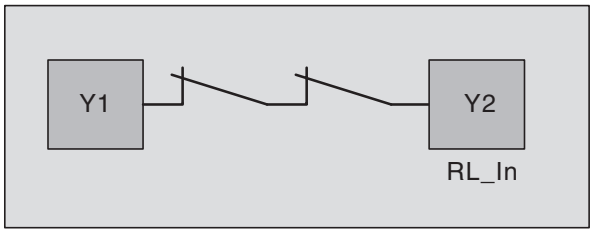
Wire the S34 reset input terminal to the 24V DC output terminal, Y1, depending on the configured reset type, as shown.



IMPORTANT If you configure the relay for automatic reset, wiring of the S34 reset input terminal is not required.

Reset Loop Input (RL_In)

The RL_In input is used to monitor the normally-closed contacts of the contactors that are used to remove power or to the feedback contacts from a drive Safe-off circuit. The signal level of the RL_In may be used to qualify a successful reset of the speed monitoring relay. For feedback loop or external device monitoring and reset qualification, wire the reset loop input, Y2 to the 24V dc output terminal Y1, as shown.



Outputs

The MSR57P relay has four safety control outputs and four diagnostic outputs. The outputs have various output current capabilities, depending on function.

See the specifications in Appendix A to verify your power requirements.

Safety Control Outputs

Safe Stop Output (SS_Out)

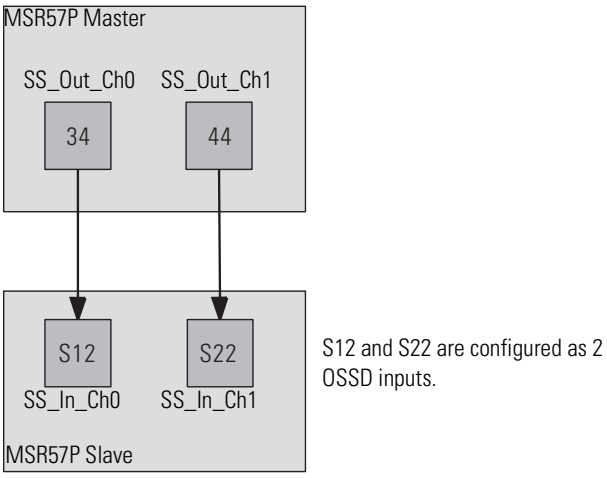
The safe state for this signal is OFF.

These outputs are typically used in multi-axis applications. In multi-axis applications, you can use these outputs to daisy-chain the master to a slave device.

For SS_Out to SS_In cascaded signals, the interface is a dual-channel sourcing solid state safety output connected to a dual-channel safety input configured as OSSD. The outputs are pulse-tested when the P72 [SS Out Mode] parameter is configured for pulse-testing.

IMPORTANT If you disable pulse-testing on this output, the achievable SIL, Category, and PL ratings of your entire MSR57P safety system are reduced.

SS_Out to SS_In Connections for Multi-axis Applications



For more information on multi-axis configurations, see Cascaded Configurations starting on page 125.

Alternately, the first SS_Out output may be used to signal a programmable logic controller (PLC) or a drive that a Safe Stop has been requested.

If the SS_In is ON (closed) and a successful Safe Stop Reset is performed, the SS_Out output is turned ON. If Lock Monitoring is not enabled or the door control logic state is Unlock, the SS_Out signal turns ON immediately when the SS_In turns ON. If Lock Monitoring is enabled, and the door control logic state is Lock, the SS_Out signal is not turned ON until the door has been locked by using the DC_Out signal and the LM_In input has been verified as ON.

If the Safe Stop Type is initiated or if a Safe Stop is initiated due to a fault, the SS_Out output is turned OFF.

If an error is detected on either channel of the dual-channel output, a fault occurs. I/O faults are Stop Category Faults, which initiate the configured Safe Stop Type. The fault is latched until the relay is successfully reset.

For more information on faults, see Chapter 12, Troubleshoot the MSR57P Relay.

Safe Limited Speed Output (SLS_Out)

The safe state for this signal in all cases is OFF.

The SLS_Out output functionality is determined by the configured Safety Mode. If the SLS_In is ON and a successful Safe Stop or Safe Limited Speed reset is performed, the SLS_Out turns ON in all Safe Limited Speed modes except Safe Limited Speed Status Only.

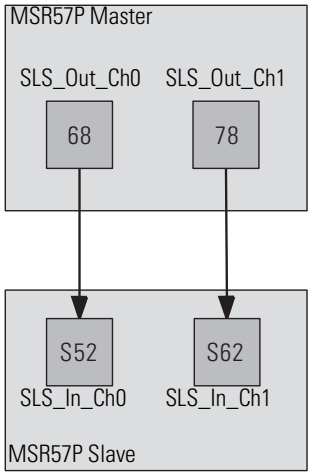
For the Safe Limited Speed modes (SLS), the SLS_Out is used to interconnect speed monitoring relays in multi-axis applications. For SLS_Out to SLS_In cascaded signals, the interface is a dual-channel sourcing solid state safety output connected to a dual-channel safety input configured as OSSD. The outputs are pulse-tested when the P73 [SLS Out Mode] parameter is configured for pulse-testing.

IMPORTANT If you disable pulse-testing on this output, the achievable SIL, Category, and PL ratings of your entire MSR57P safety system are reduced.

For a single unit system or the last unit in a cascaded system, the SLS_Out is intended to be connected to an input of a safety programmable logic controller (PLC). The same PLC could also control the Safe Stop function with a safe PLC output connected to the Safe Stop input (SS_In).

For the first or middle units in a cascaded system, the SLS_Out is intended to be connected to the Safe Limited Speed input (SLS_In) of the next relay in the cascaded system. This lets one SLS switch enable Safe Limited Speed on all axes at the same time.

SLS_Out to SLS_In Connections for Multi-axis Applications



For more information on multi-axis configurations, see Cascaded Configurations starting on page 125.

For Safe Limited Speed Status Only modes, the SLS_Out output is used as an indication that the Safe Limited Speed monitoring is active and the monitored speed is less than the configured Safe Speed Limit. If the speed is greater than or equal to the Safe Speed Limit, the SLS_Out is turned OFF. When Safe Limited Speed monitoring is not active or the relay is in a SLS Monitoring Delay [LimSpd Mon Delay], the SLS_Out output is OFF. The SLS_Out output is turned OFF when a Safe Stop has been initiated, a fault has occurred, or the relay is in the safe state.

See the Safe Limited Speed Status Only Mode on page 119 for more information.

If an error is detected on either channel of the dual-channel output, a fault occurs. I/O faults are Stop Category Faults, which initiate the configured Safe Stop Type. The fault is latched until the relay is successfully reset.

For more information on faults, see Chapter 12, Troubleshoot the MSR57P Relay.

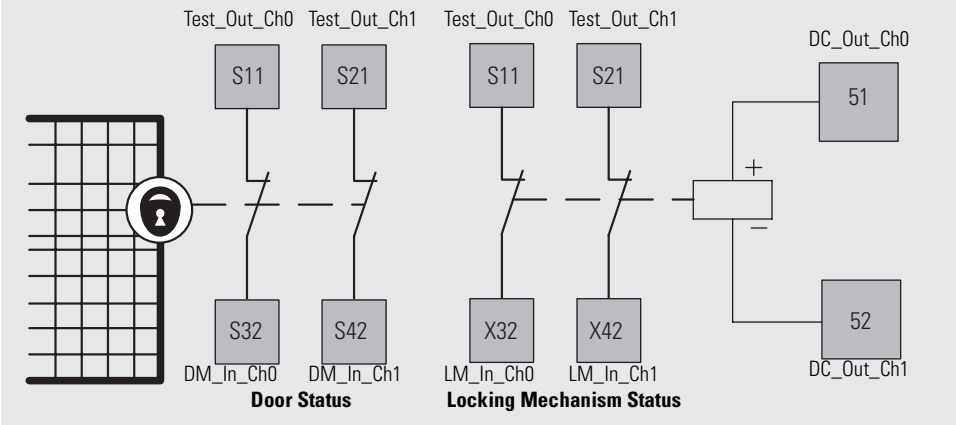
Door Control Output (DC_Out)

You can use this output for door control in single-device and multi-axis systems. This output attempts to maintain last state when a fault occurs. When no faults are present, it can be used in combination with the fault status as a standard status indication to a programmable controller to identify that the system is at Safe Limited Speed or Standstill Speed.

The DC_Out output is updated based on door control logic status, the P57 [Door Out Type] parameter setting, and any Safe State Faults that may be detected.

This output is only Unlocked when motion is verified to be at Standstill Speed or Safe Limited Speed.

Door Control, Door Monitoring, and Lock Monitoring



TIP Check your interlock switch for internal jumpers before installation.

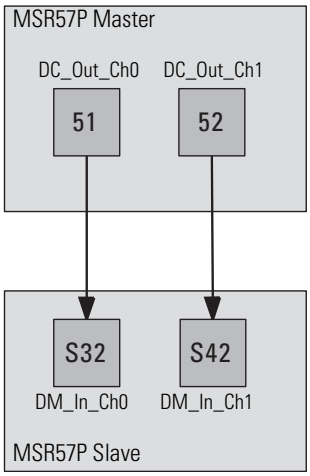
If an error is detected on either channel of the dual-channel output, a fault occurs. I/O faults are Stop Category Faults, which initiate the configured Safe Stop Type. The fault is latched until the relay is successfully reset.

For more information on faults, see Chapter 12, Troubleshoot the MSR57P Relay.

The DC_Out output may be used as a bipolar output in Power to Release or Power to Lock configurations, or it may be configured as Cascading (2Ch Sourcing).

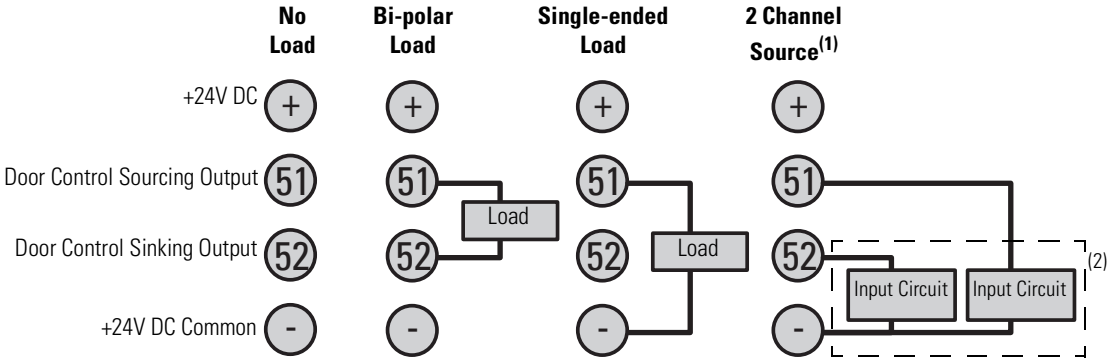
When the Door Control output is configured as cascading (2Ch Sourcing), the dual-channel bipolar output acts as two sourcing outputs capable of driving the OSSD Door Monitor input (DM_In) of the next speed monitoring safety relay in the cascaded chain. The DC_out output can also be used as a source for general purpose inputs. In this configuration, the current is limited to 20 mA.

Door Control Cascading Outputs



Only these wiring configurations, shown below, are supported for the Door Control output.

Door Control Output Wiring



(1) When wired as a source for a safety input, current is limited to 20 mA per output.

(2) For example, SmartGuard 600 controller, Guard I/O.

Short-circuits of the output loop to ground or 24V will be detected. For cascaded outputs, cross loops will also be detected.

The outputs are pulse-tested when the P74 [Door Out Mode] parameter is configured for pulse-testing.

IMPORTANT If you disable pulse-testing on this output, the achievable SIL, Category, and PL ratings of your entire MSR57P safety system are reduced.

Motion Power Output (MP_Out)

The MP_Out output is used to remove power from the drive power circuits. It is compatible with Safe-off enabled drives or applications that use standard drives with external contactors.

The safe state for this signal in all cases is OFF.

The MP_Out output is turned OFF during the Safe State and in Disabled mode.

IMPORTANT Terminal 13 must be connected to a 24V dc source to provide power to terminals 14 and 24.

The MP_Out output is turned ON by a successful reset to initiate safe speed monitoring. If Lock Monitoring is enabled and the door control logic state is Lock, the MP_Out output does not turn ON until the door has been locked via the Door Control output (DC_Out) and the Lock Monitor input (LM_In) has been verified as ON. If Lock Monitoring is disabled or the door control logic state is Unlock, the MP_Out signal turns ON immediately when the SS_In turns ON.

This table describes the ON/OFF operation of the MP_Out output based on the configured Safe Stop Type.

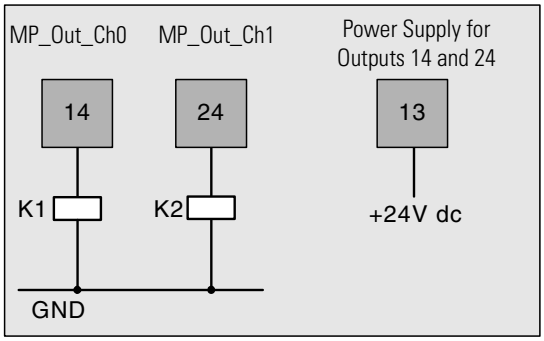
Safe Stop Type	MP_Out Status
Safe Torque Off(1)	The MP_Out output is OFF while the relay is executing the Safe Stop.
Safe Stop 1	The MP_Out output is ON while the Safe Stop is executing, unless a fault occurs. It is OFF once Standstill Speed is reached.
Safe Stop 2	The MP_Out output remains ON while the Safe Stop is executing and after Standstill Speed has been reached unless a fault occurs during the Safe Stop.

(1) With or without Standstill Checking.

The outputs are pulse-tested when the P71 [MP Out Mode] parameter is configured for pulse-testing.

IMPORTANT If you disable pulse-testing on this output, the achievable SIL, Category, and PL ratings of your entire MSR57P safety system are reduced.

For applications using standard drives with external contactors, wire the output as shown.



If an error is detected on either channel of the dual-channel output, a Motion Power Out Fault (MP Out Flt) occurs. An MP Out Flt places the relay in the Safe State. The fault is latched until a power cycle.

For more information on faults, see Chapter 12, Troubleshoot the MSR57P Relay.

Diagnostic Outputs

These signals are diagnostic status signals and are **not** safety signals.

Fault_Status Output

The Fault_Status output may be used to signal that a fault has been detected by the speed monitoring relay. The Fault_Status output is turned ON if a fault occurs.

The Fault_Status output is turned OFF by a successful reset to initiate safe speed monitoring.

Stop_Command Output

This signal is OFF when the MSR57P is in the safe state.

The Stop_Command output turns OFF at the start of the Stop Delay [Max Stop Time] when the relay is executing the configured Safe Stop Type and the Stop Monitoring Delay [Stop Mon Delay], if configured, has expired.

The Stop_Command output is turned ON by a successful reset to initiate safe speed monitoring.

The Stop_Command output is typically connected to the drive or standard PLC input card to request motion to stop. The Stop_Command output may also be used to signal a PLC or drive that the configured Stop Delay [Max Stop Time] has begun.

SLS_Command Output

The SLS_Command output is used to signal that Safe Limited Speed monitoring operation has been requested.

When Safe Limited Speed monitoring is not configured or the operating mode is Disabled, the SLS_Command is always OFF.

System Status	SLS_Command State
The relay is in the Safe State.	OFF
Safe Limited Speed monitoring is configured but inactive (SLS_In is closed).	OFF
A Safe Limited Speed Monitoring Delay [LimSpd Mon Delay] is in progress.	ON
Safe Limited Speed monitoring is active (SLS_In is open).	ON
The configured Safe Stop Type has been initiated.	Hold Last State
Standstill Speed has been reached at the end of a Safe Stop.	OFF

The SLS_Command output is turned ON by a successful Safe Stop Reset to initiate active Safe Limited Speed monitoring or to initiate a Safe Limited Speed Monitoring Delay [LimSpd Mon Delay].

This output is typically connected to the drive or standard PLC input card to request that the speed of a machine be reduced.

SLS_Status Output

The SLS_Status output is ON when Safe Limited Speed monitoring is active and the Safe Limited Speed Monitoring Delay [LimSpd Mon Delay], if configured, has expired.

General Relay and Feedback Monitoring Configuration

Introduction

This chapter describes the general and feedback configuration settings that must be configured to operate the speed monitoring relay.

Topic	Page
Cascaded Configuration	73
Safety Mode	74
Reset Type	74
Reset Qualification	75
Overspeed Response Time	75
Language Code	79
Max Display Speed	80
General Parameter List	80
Feedback Monitoring	81
Feedback Parameter List	86

Cascaded Configuration

The speed monitoring relay may be used in single-axis or multi-axis applications. The P20 [Cascaded Config] parameter indicates the relay's location in the system: Single Unit (Single), Cascaded First Unit (Multi First), Cascaded Middle Unit (Multi Mid), or Cascaded Last Unit (Multi Last). Single unit and cascaded first relays are system masters.

See Chapter 8, Slave Modes for Multi-axis Cascaded Systems for more information on cascaded configurations.

Safety Mode

The relay can be configured to operate in one of 11 user-selectable Safety Modes, based on combinations of the safety functions the relay supports. The modes, except for Disabled, are described in detail in subsequent chapters of this manual.

For These Modes	See
Master, Safe Stop (Safe Stop)	Chapter 6, Safe Stop and Safe Stop with Door Monitoring Modes
Master, Safe Stop with Door Monitoring (Safe Stop DM)	
Master, Safe Limited Speed (Lim Speed)	Chapter 7, Safe Limited Speed (SLS) Modes
Master, Safe Limited Speed with Door Monitoring (Lim Speed DM)	
Master, Safe Limited Speed with Enabling Switch Control (Lim Speed ES)	
Master, Safe Limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES)	
Master, Safe Limited Speed Status Only (Lim Spd Stat)	
Slave, Safe Stop (Slv Safe Stp)	Chapter 8, Slave Modes for Multi-axis Cascaded Systems
Slave, Safe Limited Speed (Slv Lim Spd)	
Slave, Safe Limited Speed Status Only (Slv Spd Stat)	

Reset Type

The Reset Type can be configured as automatic, manual, or manual monitored. The default is manual monitored. The configured Reset Type applies to both Safe Stop and Safe Limited Speed Resets.

TIP Reset input does not require wiring for automatic reset configurations.

See Safe Stop Reset on pages 95 and 103, and Safe Limited Speed Reset on pages 107, 111, and 113 for details on how the Reset Type affects Safe Stop and Safe Limited Speed operation.

ATTENTION

For all types of reset (automatic, manual, or manual monitored), if a reset of the Safe Stop or Safe Limited Speed functions can result in machine operation, the other speed monitoring functions must be configured to detect and prevent dangerous motion.

ATTENTION

The Safe Stop Reset does not provide safety-related restart according to EN 60204-1. Restart must be performed by external measures if automatic restart could result in a hazardous situation. You are responsible for determining whether automatic restart could pose a hazard.

Reset Qualification

Reset qualification can be configured for Safe Stop Resets. If reset qualification is configured, the MSR57P relay checks the feedback path to make sure it is a closed circuit before the reset can occur.

The P23 [Reset Loop] parameter indicates whether the Reset Loop input (RL_In) is used to qualify a successful Safe Stop Reset. If the P23 [Reset Loop] parameter equals Qualified by RL_In, the RL_in input must be ON (closed) if the motion power output (MP_Out) is in the OFF state. If the RL_In is OFF (open circuit) when the MP_Out output is OFF, a RL Fault is detected. An RL Fault is a Stop Category Fault which will prevent the reset from being successful.

If the MP_Out output is ON, the RL_In input is not required for qualification.

IMPORTANT Reset Qualification applies only to Safe Stop Reset and not to Safe Limited Speed Reset.

Overspeed Response Time

The P24 [OverSpd Response] parameter setting determines the maximum reaction time from an overspeed event to the initiation of the configured Safe Stop Type. The safety reaction time from an overspeed event that triggers a Safe Stop Type, to the actual initiation of that Safe Stop Type, is equal to the value of the P24 [OverSpd Response] parameter. The configurable options are 42, 48, 60, 84, 132, 228, and 420 ms.

The P24 [OverSpd Response] parameter setting also determines the speed resolution that can be achieved. The Overspeed Response Time and the encoder resolution affect the speed resolution accuracy as shown in the tables on the following pages.

Speed Resolution Accuracy for Rotary Systems

Encoder Resolution 16 lines/rev

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	100,000
42	156.253	156.283	156.583	159.583	189.583	489.583
48	78.127	78.142	78.292	79.792	94.792	244.792
60	39.063	39.071	39.146	39.896	47.396	122.396
84	19.532	19.535	19.573	19.948	23.698	61.198
132	9.766	9.768	9.786	9.974	11.849	30.599
228	4.883	4.884	4.893	4.987	5.924	15.299
420	2.441	2.442	2.447	2.493	2.962	7.650

Encoder Resolution 128 lines/rev

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	93,750
42	19.535	19.565	19.865	22.865	52.865	332.031
48	9.767	9.782	9.932	11.432	26.432	166.016
60	4.884	4.891	4.966	5.716	13.216	83.008
84	2.442	2.446	2.483	2.858	6.608	41.504
132	1.221	1.223	1.242	1.429	3.304	20.752
228	0.610	0.611	0.621	0.715	1.652	10.376
420	0.305	0.306	0.310	0.357	0.826	5.188

Encoder Resolution 1000 lines/rev

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	12,000
42	2.503	2.533	2.833	5.833	35.833	42.500
48	1.252	1.267	1.417	2.917	17.917	21.250
60	0.626	0.633	0.708	1.458	8.958	10.625
84	0.313	0.317	0.354	0.729	4.479	5.313
132	0.156	0.158	0.177	0.365	2.240	2.656
228	0.078	0.079	0.089	0.182	1.120	1.328
420	0.039	0.040	0.044	0.091	0.560	0.664

Encoder Resolution 1024 lines/rev

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)					
	Speed (RPM)					
	1	10	100	1000	10,000	11,718.75
42	2.445	2.475	2.775	5.775	35.775	41.504
48	1.222	1.237	1.387	2.887	17.887	20.752
60	0.611	0.619	0.694	1.444	8.944	10.376
84	0.306	0.309	0.347	0.722	4.472	5.188
132	0.153	0.155	0.173	0.361	2.236	2.594
228	0.076	0.077	0.087	0.180	1.118	1.297
420	0.038	0.039	0.043	0.090	0.559	0.648

Encoder Resolution 3000 lines/rev

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)				
	Speed (RPM)				
	1	10	100	1000	4000
42	0.837	0.867	1.167	4.167	14.167
48	0.418	0.433	0.583	2.083	7.083
60	0.209	0.217	0.292	1.042	3.542
84	0.105	0.108	0.146	0.521	1.771
132	0.052	0.054	0.073	0.260	0.885
228	0.026	0.027	0.036	0.130	0.443
420	0.013	0.014	0.018	0.065	0.221

Encoder Resolution 5000 lines/rev

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (RPM)				
	Speed (RPM)				
	1	10	100	1000	2400
42	0.503	0.533	0.833	3.833	8.500
48	0.252	0.267	0.417	1.917	4.250
60	0.126	0.133	0.208	0.958	2.125
84	0.063	0.067	0.104	0.479	1.063
132	0.031	0.033	0.052	0.240	0.531
228	0.016	0.017	0.026	0.120	0.266
420	0.008	0.008	0.013	0.060	0.133

Speed Resolution Accuracy for Linear Systems

Encoder Resolution 500 lines/mm

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)					
	Speed (mm/s)					
	0.01	0.1	1	10	100	400
42	0.083	0.084	0.087	0.117	0.417	1.417
48	0.042	0.042	0.043	0.058	0.208	0.708
60	0.021	0.021	0.022	0.029	0.104	0.354
84	0.010	0.010	0.011	0.015	0.052	0.177
132	0.005	0.005	0.005	0.007	0.026	0.089
228	0.003	0.003	0.003	0.004	0.013	0.044
420	0.001	0.001	0.001	0.002	0.007	0.022

Encoder Resolution 1000 lines/mm

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)					
	Speed (mm/s)					
	0.01	0.1	1	10	100	200
42	0.042	0.042	0.045	0.075	0.375	0.708
48	0.021	0.021	0.023	0.038	0.188	0.354
60	0.010	0.011	0.011	0.019	0.094	0.177
84	0.005	0.005	0.006	0.009	0.047	0.089
132	0.003	0.003	0.003	0.005	0.023	0.044
228	0.001	0.001	0.001	0.002	0.012	0.022
420	0.001	0.001	0.001	0.001	0.006	0.011

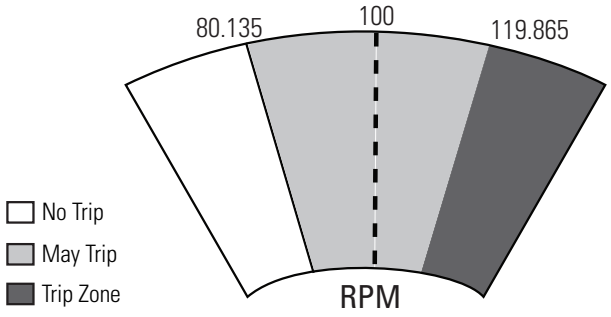
Encoder Resolution 5000 lines/mm

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)				
	Speed (mm/s)				
	0.01	0.1	1	10	40
42	0.008367	0.008667	0.011667	0.041667	0.141667
48	0.004183	0.004333	0.005833	0.020833	0.070833
60	0.002092	0.002167	0.002917	0.010417	0.035417
84	0.001046	0.001083	0.001458	0.005208	0.017708
132	0.000523	0.000542	0.000729	0.002604	0.008854
228	0.000261	0.000271	0.000365	0.001302	0.004427
420	0.000131	0.000135	0.000182	0.000651	0.002214

Encoder Resolution 20,000 lines/mm

OverSpeed Response Time (OverSpd Response) Setting	Speed Resolution Accuracy (lines/mm)			
	Speed (mm/s)			
	0.01	0.1	1	10
42	0.002117	0.002417	0.005417	0.035417
48	0.001058	0.011208	0.002708	0.017708
60	0.000529	0.000604	0.001354	0.008854
84	0.000265	0.000302	0.000677	0.004427
132	0.000132	0.000151	0.000339	0.002214
228	0.000066	0.000076	0.000169	0.001107
420	0.000033	0.000038	0.000085	0.000553

For example, an encoder resolution of 128 and OverSpeed Response Time of 42 ms results in a speed resolution accuracy of ±19.865 RPM if your Safe Maximum Speed is configured for 100.0 RPM. An SMS Speed Fault may occur when encoder 1 is at 80.135 RPM. However, the SMS Speed Fault may not occur until encoder 1 reaches 119.865 RPM.



If your encoder resolution is not listed in the tables, use these equations.

For rotary systems, the conversion from Overspeed Response Time [OverSpd Response] to Speed Resolution in revolutions per minute is:

$$\text{Speed Resolution (RPM)} = \frac{15000}{(\text{OverSpd Response} - 36) \times \text{Feedback Resolution}} + \frac{\text{Speed (RPM)} \times 0.02}{(\text{OverSpd Response} - 36)}$$

For linear systems, the conversion from Overspeed Response Time [OverSpd Response] to mm/s is:

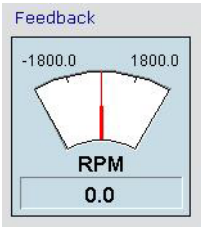
$$\text{Speed Resolution (mm/s)} = \frac{250}{(\text{OverSpd Response} - 36) \times \text{Feedback Resolution}} + \frac{\text{Speed (RPM)} \times 0.02}{(\text{OverSpd Response} - 36)}$$

Language Code

The relay can be configured for any one of seven language options: English, French, Spanish, Italian, German, Portuguese, and Dutch.

Max Display Speed

The configuration tool, HIM or software, can display a speed value based on the output speed of encoder 1 [Fbk 1 Speed]. Use the P26 [Max Display Spd] parameter to determine the scaling for the display.



General Parameter List

Set these parameters to configure general relay operation.

Parameter		Description	Setting
20	Cascaded Config	Defines whether the speed monitoring relay is a single unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Default: 0 = Single Unit (Single) Options: 0 = Single Unit (Single) 1 = Cascaded First Unit (Multi First) 2 = Cascaded Middle Unit (Multi Mid) 3 = Cascaded Last Unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Default: 1 = Master, Safe Stop (Safe Stop) Options: 0 = Disabled 1 = Master, Safe Stop (Safe Stop) 2 = Master, Safe Stop with Door Monitoring (Safe Stop DM) 3 = Master, Safe Limited Speed (Lim Speed) 4 = Master, Safe Limited Speed with Door Monitoring (Lim Speed DM) 5 = Master, Safe Limited Speed with Enabling Switch Control (Lim Speed ES) 6 = Master, Safe Limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES) 7 = Master, Safe Limited Speed Status Only (Lim Spd Stat) 8 = Slave, Safe Stop (Slv Safe Stp) 9 = Slave, Safe Limited Speed (Slv Lim Spd) 10 = Slave, Safe Limited Speed Status Only (Slv Spd Stat)
22	Reset Type	Defines the type of reset used by the safety relay.	Default: 2 = Manual Monitored (Monitored) Options: 0 = Automatic 1 = Manual 2 = Manual Monitored (Monitored)
23	Reset Loop	Defines whether the Reset Loop input (RL_In) input is used to qualify a Safe Stop Reset.	Default: 0 = Always qualified (Disable) Options: 0 = Always qualified (Disable) 1 = Qualified by RL_In (Enable)

Parameter		Description	Setting
24	OverSpd Response	Configuration for the feedback interface sampling rate.	Default: 0 = 42 ms Options: 0 = 42 ms 1 = 48 ms 2 = 60 ms 3 = 84 ms 4 = 132 ms 5 = 228 ms 6 = 420 ms
25	Language Code	Determines the language of the parameter display.	Default: 0 = English Options: 0 = English 1 = French 2 = Spanish 3 = Italian 4 = German 5 = Reserved 6 = Portuguese 7 = Reserved 8 = Reserved 9 = Dutch
26	Max Display Spd	Determines scaling for P33 [Fbk 1 Speed] process display value.	Default: 1800 Range: 1...65,535 rpm or mm/s

Feedback Monitoring

The P27 [Fbk Mode] parameter defines whether the feedback monitoring devices are configured as a single encoder or as dual encoders. When two encoders are used, the P27 [Fbk Mode] parameter also defines the type of discrepancy checking that is performed between the two encoders.

IMPORTANT Both feedback devices must be encoders.

You choose the type of feedback device, either sine/cosine or incremental for encoder 1 by using the P28 [Fbk 1 Type] parameter. You also choose the feedback type, resolution, and polarity of both encoders.

Configure the feedback type as rotary or linear by using the [Fbk *x* Units] parameter. Configure the resolution in lines per revolution or lines per millimeter by using the [Fbk *x* Resolution] parameter. In these parameter names the *x* is '1' for encoder 1 and '2' for encoder 2.

For dual encoder configurations, the resolution of the first encoder may be different than the resolution of the second encoder. After discrepancy testing has passed, the speed, relative position, and direction used by the speed monitoring relay are based on encoder 1.

IMPORTANT The resolution of encoder 1 should always be equal to or higher than the resolution of encoder 2.

Feedback Polarity

Configure the direction of polarity to be the same as the encoder or reversed by using the P30 [Fbk 1Polarity] parameter. The relay defines the normal positive direction for encoders as A leading B. To use encoders where B leads A, you must enter 1 for the P30 [Fbk 1 Polarity] parameter. Set the P35 [Fbk 2 Polarity] parameter so that the resulting speed direction is of the same polarity as encoder 1.

Single Encoder

If the P27 [Fbk Mode] parameter is set to one encoder, the single encoder input is processed redundantly and crosschecked in a 1oo2 architecture. The speed, direction, and stopped status are derived from the single encoder by the 1oo2 architecture.

Dual Encoders

If the P27 [Fbk Mode] parameter is set to two encoders, each encoder input is processed by a single channel and crosschecked in a 1oo2 architecture. Discrepancy checking is performed between the two encoders. After the discrepancy checks have passed, the speed, direction, and stopped status are derived from encoder 1.

IMPORTANT All monitoring functions are based on the speed of encoder 1. The encoder 2 signal is used for fault diagnostics.

Speed and direction checks are affected by these parameters:

- Dual Feedback Speed Ratio, P39 [Fbk Speed Ratio]
- Dual Feedback Position Tolerance, P41 [Fbk Pos Tol]
- Dual Feedback Speed Discrepancy Tolerance, P40 [Fbk Speed Tol]

Dual Feedback Speed Ratio

The Dual Feedback Speed Ratio, P39 [Fbk Speed Ratio], parameter defines the ratio of the expected speed of encoder 2 divided by the expected speed of encoder 1. This parameter configures the anticipated gearing between encoder 1 and encoder 2.

If P27 [Fbk Mode] equals 0 (one encoder), the only legal value for P39 [Fbk Speed Ratio] parameter is 0.0.

If P27 [Fbk Mode] is greater than 0, the range of legal values for P39 [Fbk Speed Ratio] is from 0.0001…10,000.0.

For example, if encoder 2's speed is expected to be 1000 revolutions per second while encoder 1's speed is expected to be 100 revolutions per second, then the P39 [Fbk Speed Ratio] should be configured as 10.0.

The units used to measure encoder speed could be either rotary (rev) or linear (mm). Any combination of rotary and linear units for the two encoders is allowed.

Dual Feedback Position Discrepancy Tolerance

The Dual Feedback Position Discrepancy Tolerance, P41 [Fbk Pos Tol] parameter defines the cumulative position discrepancy that will be tolerated between encoder 1 and encoder 2. The position discrepancy is defined as position change relative to encoder 1.

IMPORTANT The relative position discrepancy difference is reset to zero at each Safe Stop Reset.

Discrepancy checking is performed only while the Feedback Mode [Fbk Mode] is equal to one of the following values.

Feedback Mode, P27 [Fbk Mode] Parameter Setting	
1	Dual encoder with speed and position discrepancy checking
3	Dual encoder with position discrepancy checking

This table defines the legal values for each Feedback Mode value.

Feedback Mode, P27 [Fbk Mode] Values		Dual Feedback Position Discrepancy Tolerance, P41 [Fbk Pos Tol] Legal Values
0	One encoder	0
1	Dual encoder with speed and position discrepancy	1…65,535 in degrees (rotary encoders) or mm (linear encoders) relative to the resolution of encoder 1
2	Dual encoder with speed discrepancy checking	0
3	Dual encoder with position discrepancy checking	1…65,535 in degrees (rotary encoders) or mm (linear encoders) relative to the resolution of encoder 1

If an illegal value is detected, an Invalid Configuration Fault occurs and the relay remains in the Safe State.

IMPORTANT When setting discrepancy tolerances, consider that configuring a high gear ratio between encoder 1 and encoder 2 will result in a very small movement of encoder 2 translating into a very large movement from the encoder 1 perspective. This could lead to unexpected dual feedback position faults.

Dual Feedback Speed Discrepancy Tolerance

The Dual Feedback Speed Discrepancy Tolerance, P40 [Fbk Speed Tol], parameter defines the discrepancy that will be tolerated for a difference in speed between encoder 1 and encoder 2. This speed is relative to encoder 1. This discrepancy checking is only performed while the Feedback Mode is equal to one of the following values.

Feedback Mode, P27 [Fbk Mode] Parameter Setting	
1	Dual encoder with speed and position
2	Dual encoder with speed discrepancy checking

For rotary systems, the value is specified in revolutions per minute. For linear systems, the value is specified in mm per second.

Feedback Mode, P27 [Fbk Mode] Values		Dual Feedback Speed Discrepancy Tolerance, P40 [Fbk Speed Tol]
0	One encoder	0
1	Dual encoder with speed and position discrepancy checking	0.1…6553.5 in rev/min (rotary encoders) or mm/s (linear encoders)
2	Dual encoder with speed discrepancy checking	0.1…6553.5 in rev/min (rotary encoders) or mm/s (linear encoders)
3	Dual encoder with position discrepancy checking	0

If an illegal value is detected, an Invalid Configuration Fault occurs and the relay remains in the Safe State.

Feedback Voltage Monitor Range

Use the P32 [Fbk 1 Volt Mon] and P37 [Fbk 2 Volt Mon] parameters to set the feedback voltage monitoring range. The monitoring ranges help define the trip zone for encoder 1 and encoder 2, respectively.

	Fbk *x* Volt Mon Setting	5	9	12	14
	Range	**4.5…5.5V**	**7…12V**	**11…14V**	**11.5…15V**
	Trip Zone	< 4.5V	< 7V	< 11V	< 11.5V
The encoder must be specified	May Trip	4.5…4.75V	7…7.4V	11…11.6V	11.5…12.25V
to operate across this complete	No Trip	4.75…5.25V	7.4…11.4V	11.6…13.3V	12.25…14.75V
range or larger.	May Trip	5.25…5.5V	11.4…12.0V	13.3…14.0V	14.75…15.5V
	Trip Zone	>5.5V	> 12.0V	>14.0V	>15.5V

Your power supply must stay within the No Trip range.

Feedback Fault

The allowable frequency of feedback input signals is limited. The speed monitoring relay monitors feedback signals whenever the relay configuration is valid and the Safety Mode is not configured as Disabled.

Encoder Type	Maximum Frequency
Sine/cosine	≤100 kHz
Incremental	≤200 kHz

If the feedback signals indicate greater than or equal to the maximum value, a Feedback_*x* Fault (Safe State Fault) occurs.
(*x* equals 1 or 2 depending upon which encoder has the fault.)

Diagnostics are performed on the encoder input signals. If the encoder diagnostic tests fail, a Feedback_*x* Fault (Safe State Fault) occurs.

Feedback Parameter List

To define the type of feedback used by the relay, set these parameters.

Feedback Parameters

Parameter		Description	Setting	
27	Fbk Mode	Selects the number of encoders and the type of discrepancy checking.	Default:	0 = 1 encoder (Single Fbk)
			Options:	0 = 1 encoder (Single Fbk) 1 = 2 encoders (Dual S/P Chk) 2 = 2 encoders speed discrepancy checking (Dual Spd Chk) 3 = 2 encoders position discrepancy checking (Dual Pos Chk)
28	Fbk 1 Type	Selects the type of feedback for encoder 1.	Default:	1 = TTL (Incremental)
			Options:	0 = Sine/cosine 1 = TTL (Incremental)
29	Fbk 1 Units	Selects linear or rotary feedback for encoder 1.	Default:	0 = Rotary (Rev)
			Options:	0 = Rotary (Rev) 1 = Linear (mm)
30	Fbk 1 Polarity	Defines the direction polarity for encoder 1.	Default:	0 = Same as encoder (Normal)
			Options:	0 = Same as encoder (Normal) 1 = Reversed
31	Fbk 1 Resolution	Counts/Revolution.	Default:	1024
			Range:	1...65,535 pulses/revolution or pulses/mm based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter

Feedback Parameters

Parameter		Description	Setting
32	Fbk 1 Volt Mon	Encoder 1 voltage to be monitored.	Default: 0 = Voltage not monitored Options: 0 = Voltage not monitored 5 = 5V ±10% 9 = 7...12V 12 = 11...14V 14 = 11.5...15.5V
33	Fbk 1 Speed(1)	Displays the output speed of encoder 1.	Range: -214,748,364.8...214,748,364.7 rpm or mm/s based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
34	Fbk 2 Units	Selects rotary or linear feedback system for encoder 2.	Default: 0 = Rotary (Rev) Options: 0 = Rotary (Rev) 1 = Linear (mm)
35	Fbk 2 Polarity	Defines the direction polarity for encoder 2.	Default: 0 = Same as encoder (Normal) Options: 0 = Same as encoder (Normal) 1 = Reversed
36	Fbk 2 Resolution	Counts/Revolution.	Default: 0 Range: 0...65,535 pulses/revolution o pulses/mm based on rotary or linear configuration defined by the P34 [Fbk 2 Units] parameter
37	Fbk 2 Volt Mon	Encoder 2 voltage to be monitored. Not valid when P27 [Fbk Mode] = 0 (1 encoder).	Default: 0 = Voltage not monitored Options: 0 = Voltage not monitored 5 = 5V ±10% 9 = 7...12V 12 = 11...14V 14 = 11.5...15.5V
38	Fbk 2 Speed(1)	Displays the output speed of encoder 2.	Range: -214,748,364.8...214,748,364.7 rpm or mm/s
39	Fbk Speed Ratio	Dual Feedback Speed Ratio. Defines the ratio of the expected speed of encoder 2 divided by the expected speed of encoder 1 Not valid when P27 [Fbk Mode] = 0 (1 encoder).	Default: 0.0000 Range: 0.0001...10,000.0 ratio based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter
40	Fbk Speed Tol	Dual Feedback Speed Discrepancy Tolerance. Acceptable difference in speed between [Fbk 1 Speed] and [Fbk 2 Speed].	Default: 0 Range: 0...6553.5 rpm or mm/s units are based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter
41	Fbk Pos Tol	Acceptable difference in position between encoder 1 and encoder 2.	Default: 0 Range: 0...65,535 deg or mm units are based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter

(1) Read-only.

Safe Stop and Safe Stop with Door Monitoring Modes

Introduction

This chapter describes the Safe Stop modes of safety operation and provides a list of configuration parameters as well as wiring examples for each Safe Stop mode.

Topic	Page
Safe Stop Mode	89
Safe Stop Parameter List	99
Safe Stop Wiring Example	102
Safe Stop with Door Monitoring Mode	102
Safe Stop with Door Monitoring Parameter List	103
Safe Stop with Door Monitoring Wiring Example	104

Safe Stop Mode

When properly configured for Safe Stop, the relay monitors the Safe Stop input (SS_In) and initiates the configured Safe Stop Type upon deactivation of the input. The Safe Stop Type is configurable as either Safe Torque Off with or without Standstill Checking, Safe Stop 1, or Safe Stop 2. The relay recognizes motion as stopped when the encoder 1 feedback signals indicate the system has reached the configured Standstill Speed. Once Standstill Speed has been reached, the Door Control output (DC_Out) is set to Unlock.

In addition to setting the Standstill Speed, you configure both the Stop Delay [Max Stop Time], the period during which deceleration occurs after a Safe Stop is initiated, and an optional Stop Monitoring Delay [Stop Mon Delay], which is a delay between the action that requests the Safe Stop and the initiation of the configured Safe Stop Type. A Stop Monitoring Delay can only be configured for Safe Stop 1 or Safe Stop 2.

When properly configured for Safe Stop mode, the relay also monitors for faults and initiates the appropriate reaction. If the fault is a Safe State Fault, the relay enters the Safe State. If the fault is a Stop Category Fault, the relay initiates the configured Safe Stop Type.

Safe Stop Types

Use the P45 [Safe Stop Type] parameter to configure the type of stop that the system executes when a Safe Stop is initiated. A Safe Stop can be initiated by a transition of the SS_In input from ON to OFF or by the occurrence of a Stop Category Fault.

While the relay executes the configured Safe Stop Type, it continues to monitor the system. If a Stop Category Fault is detected, the relay sets the outputs to a faulted state, but allows for the door control logic to be set to Unlock if the feedback signals indicate the configured Standstill Speed has been reached.

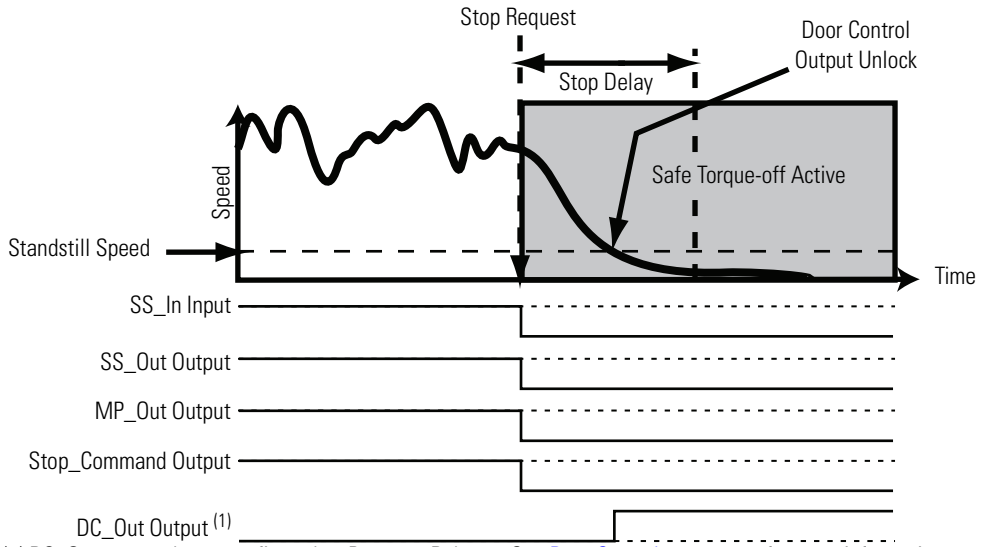
Safe Torque Off with Standstill Checking

This Safe Stop Type lets you access the hazard area immediately after motion is detected as stopped rather than waiting until a specific time has elapsed.

When Safe Torque Off with Standstill Checking is initiated, power is removed from the Motion Power output (MP_Out) immediately and the configured Stop Delay [Max Stop Time] begins. If the configured Standstill Speed is detected any time after the Safe Stop has been initiated and before the end of the configured Stop Delay [Max Stop Time], door control logic is set to Unlock.

If the Standstill Speed is not detected by the end of the configured Stop Delay [Max Stop Time] a Stop Speed Fault occurs and the door control logic remains set to Lock until Standstill Speed is detected. A Stop Speed Fault removes power from the Motion Power output (MP_Out) immediately.

Timing Diagram for Safe Torque Off with Standstill Checking



(1) DC_Out output shown configured as Power to Release. See Door Control on page 97 for more information.

Safe Stop 1 and Safe Stop 2

When Safe Stop 1 or 2 is initiated by a transition of the SS_In input from ON to OFF, the relay does not initiate the configured Stop Delay [Max Stop Time] until after the optional Stop Monitoring Delay [Stop Mon Delay] expires, unless a Stop Category Fault occurs during the Stop Monitoring Delay.

When Safe Stop 1 or 2 is initiated by a Stop Category Fault, the Stop Delay [Max Stop Time] begins immediately, regardless of whether a Stop Monitoring Delay [Stop Mon Delay] is configured.

Deceleration monitoring takes place during the Stop Delay [Max Stop Time]. These three configurable parameters define the deceleration profile that is used.

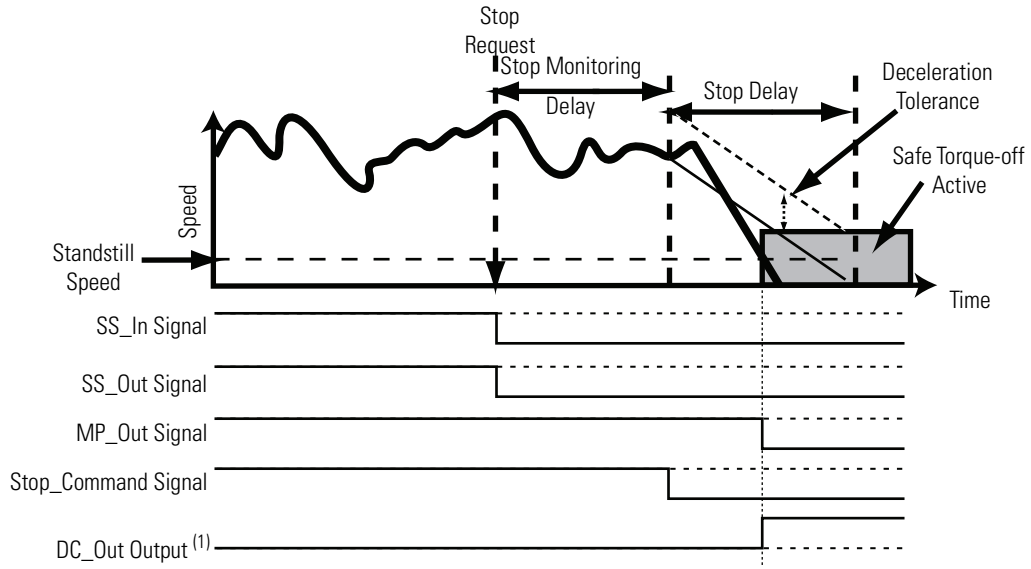
- Deceleration Reference Speed, P50 [Decel Ref Speed]
- Deceleration Tolerance, P51 [Stop Decel Tol]
- Stop Delay, P47 [Max Stop Time]

If Standstill Speed is detected any time after the Safe Stop has been initiated and before the Stop Delay [Max Stop Time] expires, door control logic is set to Unlock.

If the Standstill Speed is not detected by the end of the configured Stop Delay [Max Stop Time], a Stop Speed Fault occurs.

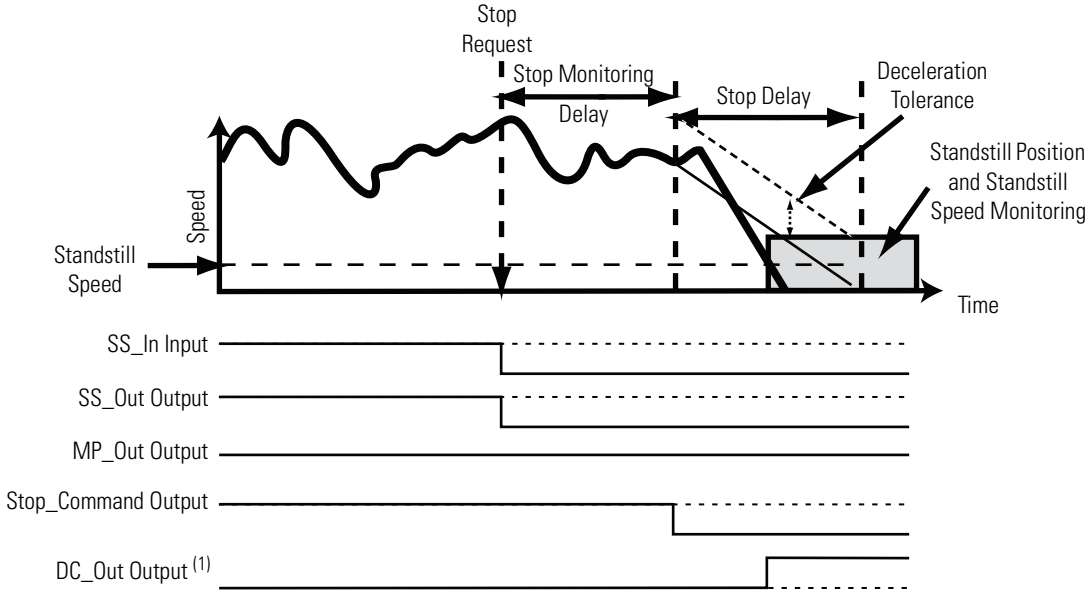
For Safe Stop 1, power is removed from the Motion Power output (MP_Out) when Standstill Speed is reached. For Safe Stop 2, power is not removed.

Timing Diagram for Safe Stop 1



(1) DC_Out Output shown configured as Power to Release. See Door Control on page 97 for more information.

Timing Diagram for Safe Stop 2

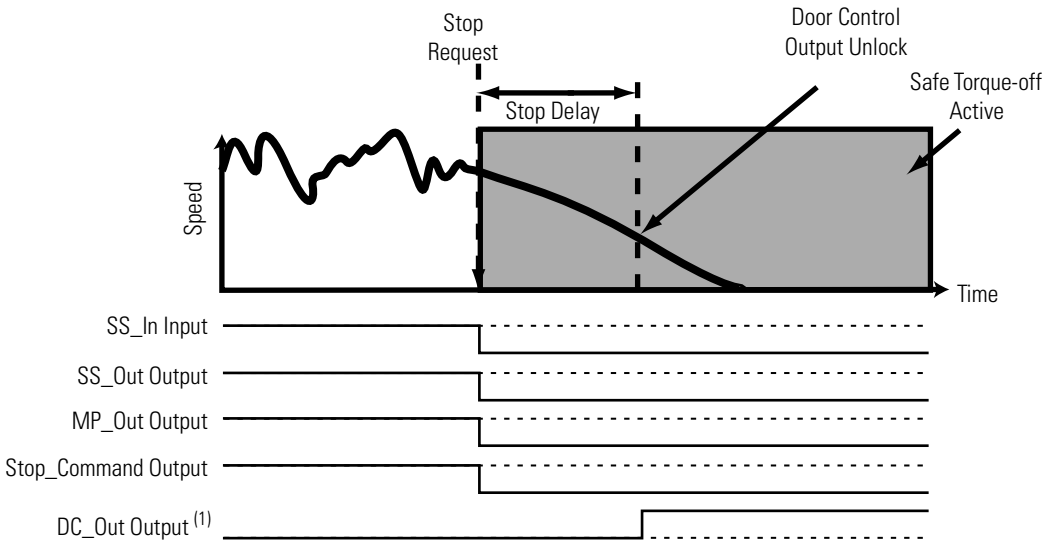


(1) DC_Out output shown configured as Power to Release. See Door Control on page 97 for more information.

Safe Torque Off without Standstill Checking

When Safe Torque Off without Standstill Checking is initiated, motion power is removed immediately and the configured Stop Delay [Max Stop Time] begins. Door control logic is set to Unlock when the Stop Delay [Max Stop Time] expires, regardless of speed.

Timing Diagram for Safe Torque Off without Standstill Checking



(1) DC_Out output shown configured as Power to Release. See Door Control on page 97 for more information.

TIP All Stop Types require an encoder to be connected.

Standstill Speed and Position Tolerance

For Safe Stop Types that include Standstill Checking, you set the Standstill Speed and Standstill Position Tolerance.

IMPORTANT The P48 [Standstill Speed] and P49 [Standstill Pos] parameters are not used for Safe Torque Off without Standstill Checking configurations. Set these parameters to zero.

Standstill Speed is used to declare motion as stopped. The system is at standstill when the speed detected is less than or equal to the configured Standstill Speed. The P48 [Standstill Speed] parameter defines the speed limit before the relay determines standstill has been reached and the door control logic is set to Unlock.

IMPORTANT Standstill detection relies on the encoder 1 signal. The encoder 2 signal is used for fault diagnostics.

The P49 [Standstill Pos] parameter defines the position limit in encoder 1 units that is tolerated after standstill has been reached. If the position changes by more than the amount specified by the Standstill Position Tolerance, after standstill has been reached and the door is unlocked, a Motion After Stopped Fault occurs. This type of fault results in the MSR57P relay entering the safe state.

The time required to verify that the Standstill Speed has been reached can be considerable when a very small Standstill Speed is configured and the encoder resolution of encoder 1 is very low.

- For rotary systems, the time (in seconds) will exceed 15 / [Standstill Speed (RPM) x Encoder 1 Resolution].
- For linear systems, the time (in seconds) will exceed 0.25 / [Standstill Speed (mm/s) x Encoder 1 Resolution].

Deceleration Monitoring

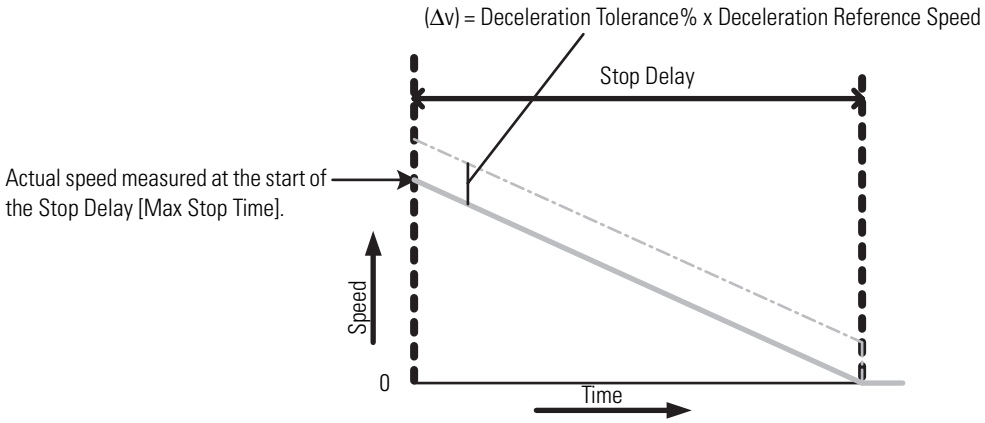
Deceleration monitoring takes place during the configured Stop Delay [Max Stop Time], when the Safe Stop Type is configured as Safe Stop 1 or Safe Stop 2. The deceleration start speed is captured at the beginning of the Stop Delay [Max Stop Time] and used to calculate the deceleration profile.

These parameters define the deceleration profile.

- Deceleration Reference Speed, P50 [Decel Ref Speed]
- Deceleration Tolerance, P51 [Stop Decel Tol]
- Stop Delay, P47 [Max Stop Time]

The Deceleration Reference Speed is relative to encoder 1. The P51 [Stop Decel Tol] parameter defines the percentage of the Deceleration Reference Speed that will be tolerated above the calculated deceleration profile.

Deceleration Monitoring


(Δv) = Deceleration Tolerance% x Deceleration Reference Speed
Stop Delay
Actual speed measured at the start of the Stop Delay [Max Stop Time].
Speed
0
Time

TIP To account for system overshoot and drive delay, choose Δv and set P50 [Decel Ref Speed] to the highest normal operating speed to calculate the Deceleration Tolerance. Remember that P51 [Stop Decel Tol] parameter is a percentage.

When deceleration monitoring is being performed, the speed limit monitored during the Stop Delay [Max Stop Time] must be less than the Deceleration Monitoring Value or a Deceleration Fault occurs. A Deceleration Fault places outputs in the faulted state, but allows the door to be unlocked when the feedback signals indicate Standstill Speed has been reached.

Safe Stop Reset

The Safe Stop Reset (SS Reset) is a reset from the Safe State or from a stopping condition to actively monitoring motion. The reset is successful if the SS_In input is ON, no faults are present, and, if reset qualification (P23 [Reset Loop]) is configured, the qualification is met.

ATTENTION

For all types of reset (automatic, manual, or manual monitored), if a reset of the Safe Stop or Safe Limited Speed functions can result in machine operation, the other speed monitoring functions must be configured to detect and prevent dangerous motion.

ATTENTION

The Safe Stop Reset does not provide safety-related restart according to EN 60204-1. Restart must be performed by external measures if automatic restart could result in a hazardous situation. You are responsible for determining whether automatic restart could pose a hazard.

When an SS Reset is requested, all diagnostic tests that can be performed prior to outputs being energized are performed prior to a successful SS Reset. If a diagnostic test can only be performed when outputs are energized, the test is performed immediately following the SS Reset.

IMPORTANT An SS Reset is not attempted if the Wait No Stop attribute is set (1), indicating that the HIM stop button was pressed or a stop command was issued from DriveExecutive or DriveExplorer software.

The Wait No Stop attribute is bit 26 of the P68 [Guard Status] parameter.

IMPORTANT An SS Reset is not attempted if the Wait SS Cyc attribute is set (1), indicating that an error occurred.

The Wait SS Cyc attribute is bit 25 of the P68 [Guard Status] parameter.

Automatic

If the SS Reset is configured as automatic, the relay always attempts a reset if it is in the Safe State or has initiated a Safe Stop Type. The reset is attempted when the SS_In input transitions from OFF to ON or if SS_In is ON at power-up.

Manual

If the SS Reset is configured as manual, the reset occurs when the SS_In input is ON and the Reset_In input is ON.

Manual Monitored

A manual monitored reset requires an OFF to ON to OFF transition of the Reset_In input.

If at any time before the closing and opening of the Reset_In input, the SS_In input transitions from ON to OFF, the reset is aborted.

Faults

If a fault occurs, other than an Invalid Configuration Fault or an ESM Monitoring Fault, the SS_In input must turn OFF and ON again to reset the Wait SS Cyc bit before a successful SS Reset can occur.

Door Control

The status of door control logic (Lock or Unlock) and the Door Monitor Input (DM_In), along with the relay's location in the system [Cascaded Config] and Door Control Output Type [Door Out Type] determine whether the Door Control output (DC_Out) is locked or unlocked during normal operation.

When the DC_Out output has no faults, the relay is configured for Safe Stop, and the relay is monitoring motion, the door control logic state is Locked. It remains locked while a Safe Stop is being executed. For all Safe Stop Types except Safe Torque Off without Standstill Checking, door control logic is set to Unlock only when Standstill Speed has been reached. If the Safe Stop Type is Safe Torque Off without Standstill Checking, door control logic is set to Unlock when the Stop Delay [Max Stop Time] has elapsed, regardless of speed.

Configuration

You configure the type of door control for each speed monitoring safety relay in the system.

Configure Door Control Output Type

P57 [Door Out Type] Settings		DC_Out Status and Lock State
Single and Last Units	**First and Middle Units**	
0 = Power to Release	Not valid	ON = Door is unlocked. OFF = Door is locked.
1 = Power to Lock	Not valid	ON = Door is locked. OFF = Door is unlocked.
2 = Cascading (2 Ch Sourcing)	2 = Cascading (2 Ch Sourcing)	ON = Door is unlocked. OFF = Door is locked.

A single relay or last relay in a cascaded system can be configured for any Door Output Type setting. For example, choose 2 Ch Sourcing to connect to a safety programmable controller input. First or middle relays in a cascaded system must be configured as 2 Ch Sourcing.

ATTENTION

When the DC_Out output is configured as Power to Lock (P57 [Door Out Type] = 1), the safe state and faulted state is Unlocked.

Make sure that this possibility does not create a hazard.

IMPORTANT

When the DC_Out output is configured for no pulse testing (P74 [Door Out Mode] = 1) and the P57 [Door Out Type] setting is Power to Lock, and a reset is attempted, the DC_Out output is pulsed low for 12 ms. During the 12 ms, the door is unlocked.

Effect of Faults

These fault conditions, which affect the integrity of the DC_Out output, will force the DC_Out output to its safe state (OFF) regardless of the status of door control logic:

- DC Out Fault
- Invalid Configuration Fault
- Internal Power Supply or MPU Faults

ATTENTION

If a fault occurs after Standstill Speed has been reached, door control remains unlocked.

For fault conditions where the DC_Out output can maintain its integrity, both door control logic and the DC_Out output hold last state. If hold last state cannot be maintained, faults may turn the DC_Out output OFF.

ATTENTION

If a fault occurs while the door is unlocked, it may remain unlocked. Make sure that this possibility does not create a hazard.

Lock Monitoring

If Lock Monitoring is enabled, the Lock Monitoring input (LM_In) must be in the ON state any time the Door Control output (DC_Out) is in the Lock state, except for the 5 seconds following the DC_Out output's transition from the Unlocked state to the Locked state. If the LM_In input is not ON during this time, a Lock Monitoring Fault occurs. The LM_In input must be OFF when the DM_In input transitions from ON to OFF (the door opens).

A Lock Monitoring Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

Safe Stop Parameter List

To configure the relay for Safe Stop mode, set these parameters in addition to the General and Feedback parameters listed on pages 80 and 86.

Safe Stop Parameters

Parameter		Description	Setting
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting: 1 = Safe Stop
44	Safe Stop Input	Configuration for Safe Stop input (SS_In).	Default: 1 = Dual-channel equivalent Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)
45	Safe Stop Type	Safe operating stop type selection. This defines the type of Safe Stop that is performed if the Safe Stop function is initiated by a stop type condition.	Default: 0 = Safe Torque Off with Standstill Checking (Torque Off) Options: 0 = Safe Torque Off with Standstill Checking (Torque Off) 1 = Safe Stop 1 2 = Safe Stop 2 3 = Safe Torque Off without Standstill Checking (Trq Off NoChk)
46	Stop Mon Delay	Defines the monitoring delay between the request for a Safe Stop and the start of the Stop Delay [Max Stop Time] when the request for a Safe Stop 1 or a Safe Stop 2 is initiated by an SS_In input ON to OFF transition. If the Safe Stop Type is Safe Torque Off with or without Speed Checking, the Stop Monitoring Delay must be 0 or a Invalid Configuration Fault occurs.	Default: 0 Range: 0...6553.5 s

Safe Stop Parameters

Parameter		Description	Setting
47	Max Stop Time	Stop Delay Defines the maximum stop delay time that is used when the Safe Stop function is initiated by a stop type condition.	Default: 0 Range: 0...6553.5 s
48	Standstill Speed	Defines the speed limit that is used to declare motion as stopped. Not valid for Safe Torque Off without Standstill Checking.	Default: 0.001 Range: 0.001...65.535 rpm or mm/s based on rotary or linear configuration defined by encoder 1 feedback configuration P29 [Fbk 1 Units] parameter
49	Standstill Pos	Standstill Position Window. Defines the position limit in encoder 1 degrees or mm, that will be tolerated after a Safe Stop condition has been detected. Not valid for Safe Torque Off without Standstill Checking.	Default: 10 Range: 0...65,535 degrees (360° = 1 revolution) or mm based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
50	Decel Ref Speed	Decel Reference Speed. Determines deceleration rate to monitor for Safe Stop 1 or Safe Stop 2.	Default: 0 Range: 0...65,535 rpm or mm/s based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
51	Stop Decel Tol	Decel Tolerance. This is the acceptable tolerance above the deceleration rate set by the Decel Ref Speed parameter.	Default: 0 Range: 0...100% of Decel Ref Speed
57	Door Out Type	Defines the lock and unlock state for the door control output (DC_Out). Door Out Type can be 0 or 1 only for a single-axis system or for the last unit in a multi-axis system. The first and middle units of a multi-axis system must be configured as cascading (2).	Default: 0 = Power to release (Pwr to Rel) Options: 0 = Power to release (Pwr to Rel) 1 = Power to lock (Pwr to Lock) 2 = Cascaded (2 Ch Sourcing)
59	Lock Mon Enable	Lock Monitoring can only be enabled when the speed monitoring safety relay is a single unit or as the first unit in a multi-axis system (P20 [Cascaded Config] equals 0 or 1).	Default: 0 = Disabled Options: 0 = Disabled 1 = Enabled

Safe Stop Parameters

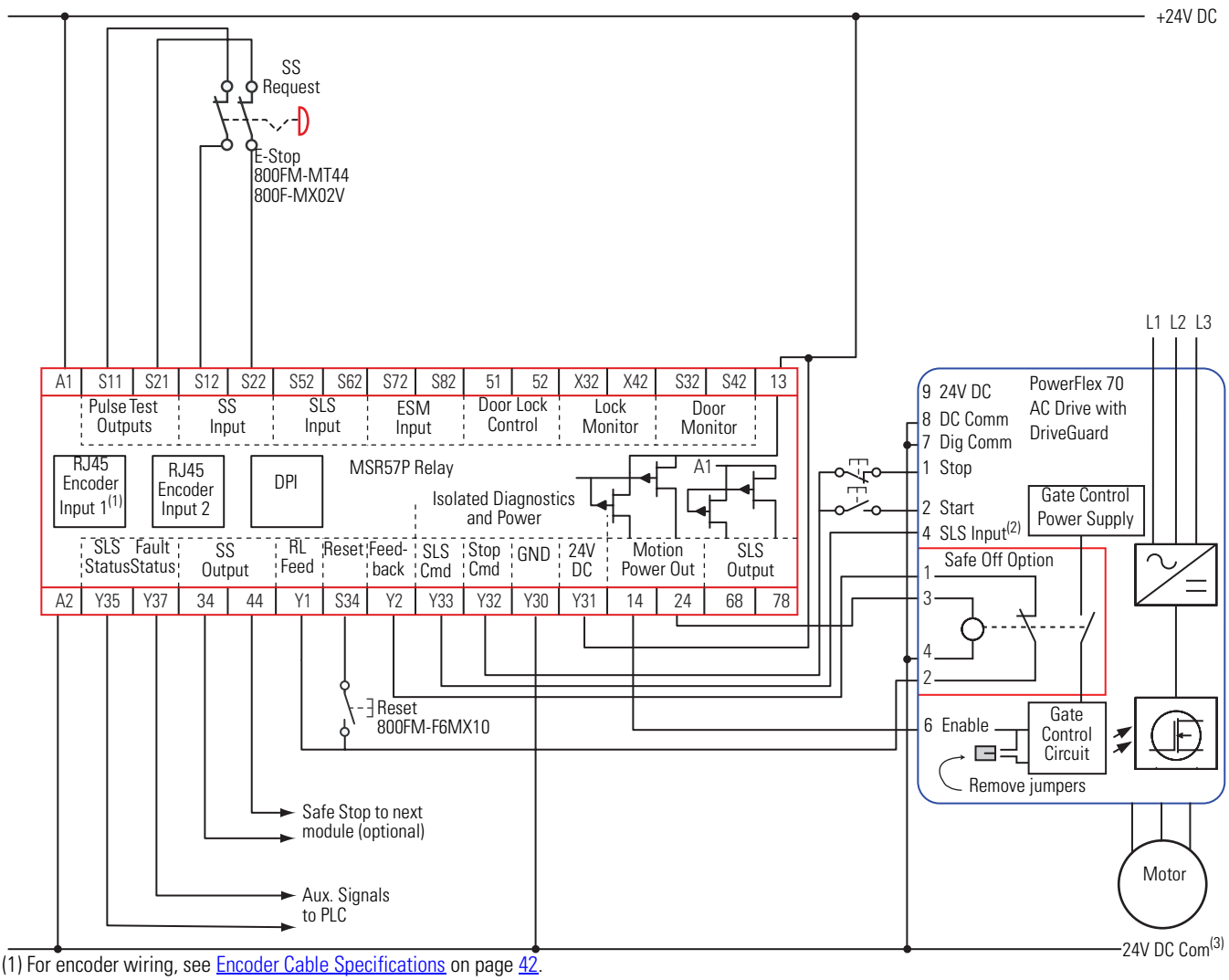
Parameter		Description	Setting
60	Lock Mon Input	Configuration for the Lock Monitor input (LM_In).	Default: 0 = Not used
			Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)
71	MP Out Mode	Defines whether the MP_Out output is pulse-tested.(1)	Default: 0 = Pulse Test
			Options: 0 = Pulse test 1 = No pulse test
72	SS Out Mode	Defines whether the SS_Out output is pulse-tested.(1)	Default: 0 = Pulse Test
			Options: 0 = Pulse test 1 = No pulse test
74	Door Out Mode	Defines whether the DC_Out output is pulse-tested.(1)	Default: 0 = Pulse Test
			Options: 0 = Pulse test 1 = No pulse test

(1) If pulse-testing is turned off for any output, the SIL, Category, and PL rating is reduced for the entire MSR57P safety system.

Safe Stop Wiring Example

This example illustrates safe stop wiring.

Master, Safe Stop (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safe Stop with Door Monitoring Mode

When properly configured for Safe Stop with Door Monitoring, the relay monitors the Safe Stop input (SS_In) and initiates the configured Safe Stop Type upon deactivation of the input as described in Safe Stop Mode on page 89.

In addition, the speed monitoring relay verifies through monitoring the Door Monitor input (DM_In) that the device controlled by the Door Control output (DC_Out) is in an expected state. The DM_In input is ON when the door is closed and OFF when the door is open. If the door is monitored as opened during Safe Stop monitoring, a

Door Monitoring Fault occurs and the speed monitoring relay initiates the configured Safe Stop Type.

You can monitor the door's status with or without using the Door Control (lock/unlock) function. When door control logic is set to Lock, the MSR57P relay puts the solenoid into the locked state when the machine is not at a safe speed or at Standstill Speed.

Lock Monitoring

If a Safety Mode that includes Door Monitoring is selected and Lock Monitoring is enabled, the Lock Monitor input (LM_In) signal must be OFF any time that the Door Monitor input (DM_In) transitions from ON to OFF.

IMPORTANT If your application uses Lock Monitoring without Door Monitoring, you must use some means to make sure that the Lock Monitor is not stuck at a Lock indication.

SS Reset

If the Door Monitor input (DM_In) is OFF when a Safe Stop (SS) Reset is attempted in any state other than actively monitoring Safe Limited Speed, a Door Monitoring Fault occurs and the speed monitoring relay initiates the configured Safe Stop Type.

Safe Stop with Door Monitoring Parameter List

To configure the relay for Safe Stop with Door Monitoring, set the DM Input parameter in addition to the Safe Stop parameters listed on page 99.

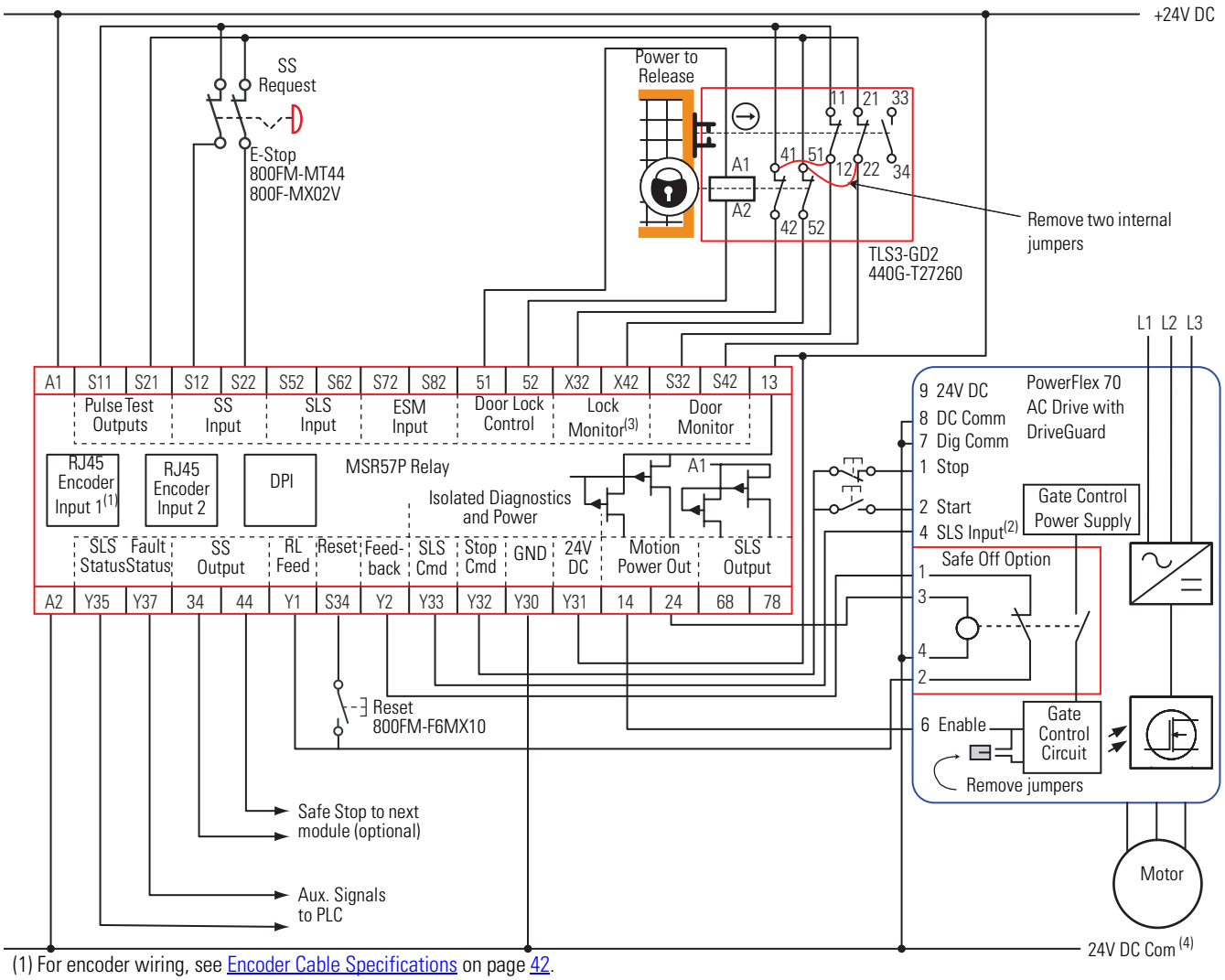
Parameter		Description	Setting
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting: 2 = Master, Safe Stop with Door Monitoring (Safe Stop DM)
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default: 0 = Not used(1)
			Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)

(1) You must configure this parameter with a non-zero value in this mode.

Safe Stop with Door Monitoring Wiring Example

This example illustrates wiring for safe stop with door monitoring.

Master, Safe Stop with Door Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safe Stop with Door Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safe Limited Speed (SLS) Modes

Introduction

This chapter describes the Safe Limited Speed (SLS) modes of safety operation and provides a list of configuration parameters along with wiring examples for each mode.

Topic	Page
Safe Limited Speed (SLS) Mode	105
Safe Limited Speed Parameter List	108
Safe Limited Speed Wiring Example	109
Safe Limited Speed with Door Monitoring Mode	110
SLS with Door Monitoring Parameter List	111
SLS with Door Monitoring Wiring Example	112
Safe Limited Speed with Enabling Switch Monitoring Mode	112
SLS with Enabling Switch Monitoring Parameter List	114
SLS with Enabling Switch Monitoring Wiring Example	115
Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring Mode	115
SLS with Door Monitoring and Enabling Switch Monitoring Parameter List	118
SLS with Door Monitoring and Enabling Switch Monitoring Wiring Example	119
Safe Limited Speed Status Only Mode	119
SLS Status Only Parameter List	121
SLS Status Only Wiring Examples	122

Safe Limited Speed (SLS) Mode

When properly configured for Safe Limited Speed, the relay performs Safe Limited Speed (SLS) monitoring functions in addition to the Safe Stop function described in Safe Stop Mode on page 89. When the Safe Limited Speed input (SLS_In) is OFF, feedback velocity is monitored and compared against a configurable Safe Speed Limit.

If the feedback velocity is below the Safe Speed Limit during Safe Limited Speed monitoring, the Door Control output (DC_Out) is unlocked after the Safe Limited Speed Monitoring Delay [Lim Spd Mon Delay], if configured, has expired.

ATTENTION

Make sure that an unlocked door does not result in a hazardous situation.

If a Safe Stop Type is initiated or a fault occurs while the relay is actively monitoring Safe Limited Speed, door control remains unlocked. The safe state of the SLS_In input may allow the door be unlocked.

If the measured velocity exceeds the Safe Speed Limit, an SLS Fault occurs and the configured Safe Stop Type is initiated. An optional Safe Limited Speed Monitoring Delay [Lim Spd Mon Delay] can be configured to delay the start of Safe Limited Speed monitoring.

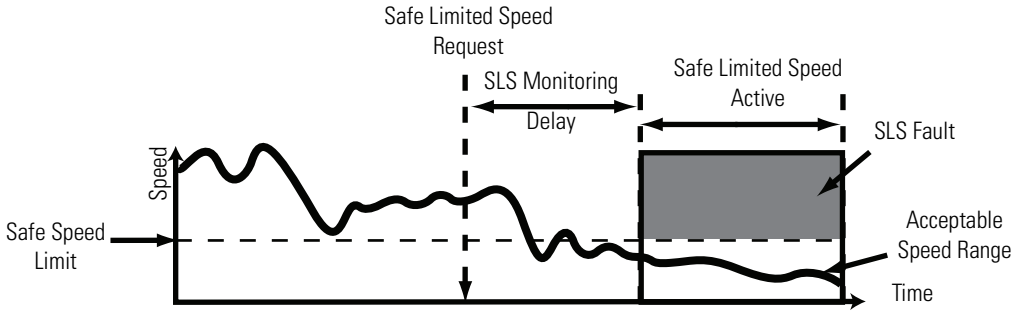
Safe Limited Speed monitoring is requested by a transition of the Safe Limited Speed input (SLS_In) from ON to OFF. When the SLS_In input is ON, the relay does not monitor for Safe Limited Speed and the measured velocity can be above or below the Safe Speed Limit.

ATTENTION

If the Reset Type is configured as Automatic, Safe Limited Speed monitoring is disabled when the SLS_In input is turned ON and the machine operates at its normal run speed. Make sure that the SLS_In input cannot transition to ON while someone is in the hazardous area.

If you configure a Safe Limited Speed Monitoring Delay [Lim Spd Mon Delay], the delay begins when Safe Limited Speed monitoring is requested by the SLS_In transition from ON to OFF. The relay begins monitoring for Safe Limited Speed when the delay times out. If system speed is greater than or equal to the configured Safe Speed Limit during Safe Limited Speed monitoring, an SLS Fault occurs and the relay initiates the configured Safe Stop Type.

Timing Diagram for Safe Limited Speed (SLS)



Safe Limited Speed Reset

A Safe Limited Speed (SLS) Reset is a transition out of actively monitoring safe limited speed. It can also occur during a Safe Limited Speed Monitoring Delay [Lim Spd Mon Delay], if one is configured. When an SLS Reset occurs, the relay no longer monitors for safe limited speed and the door is locked. Speed is no longer restricted to the configured Safe Speed Limit.

The SLS Reset function monitors the SLS_In input. If an SLS Reset is requested, the relay checks that no faults are present and verifies that the SLS_In input is ON (closed circuit) before the reset is performed.

When the input is OFF, Safe Limited Speed monitoring takes place, after the SLS Monitoring Delay [Lim Spd Mon Delay], if one is configured. An SLS Reset can be requested during active Safe Limited Speed monitoring or during a Safe Limited Speed Monitoring Delay. If a reset is requested during a Safe Limited Speed Monitoring Delay, the reset does not wait for the delay to time out.

Automatic

Once the SLS_In input is ON (closed), the relay lets the drive resume normal operating speed. No reset button is required to re-enter the normal run state.

Manual

When the SLS_In input transitions from OFF to ON and the Reset_In input is ON, an SLS_Reset is attempted.

If the SLS_In transitions from OFF to ON and the Reset_In input is OFF, the relay stays in its current state, whether it is actively monitoring Safe Limited Speed or is in a Safe Limited Speed Monitoring Delay, and waits for the Reset_In input to transition to ON, before attempting the SLS_Reset. If at any time, the SLS_In input transitions back to OFF, the SLS_Reset is aborted.

Manual Monitored

When the SLS_In input transitions from OFF to ON, the relay waits for an OFF to ON to OFF transition of the Reset_In input before an SLS_Reset is attempted. If at any time during this period, the SLS_In input transitions back to OFF, the SLS_Reset is aborted.

Safe Limited Speed Parameter List

To configure the relay for Safe Limited Speed monitoring, set these parameters in addition to the Safe Stop parameters listed beginning on page 99.

Parameter		Description	Setting
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting: 3 = Master, Safe Limited Speed (Lim Speed)
52	Lim Speed Input	Configuration for the Safe Limited Speed input (SLS_In).	Default: 0 = Not used(2) Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)
53	LimSpd Mon Delay	Defines the Safe Limited Speed Monitoring Delay between the SLS_In ON to OFF transition and the initiation of the Safe Limited Speed (SLS) monitoring.	Default: 0 Range: 0...6553.5 s
55	Safe Speed Limit	Defines the speed limit that will be monitored in Safe Limited Speed (SLS) mode.	Default: 0 Range: 0...6553.5 rpm or mm/s based on rotary or linear configuration defined by the encoder 1 feedback configuration P29 [Fbk 1 Units] parameter
73	SLS Out Mode	Defines whether the SLS_Out output is pulse-tested.(1)	Default: 0 = Pulse Test Options: 0 = Pulse test 1 = No pulse test

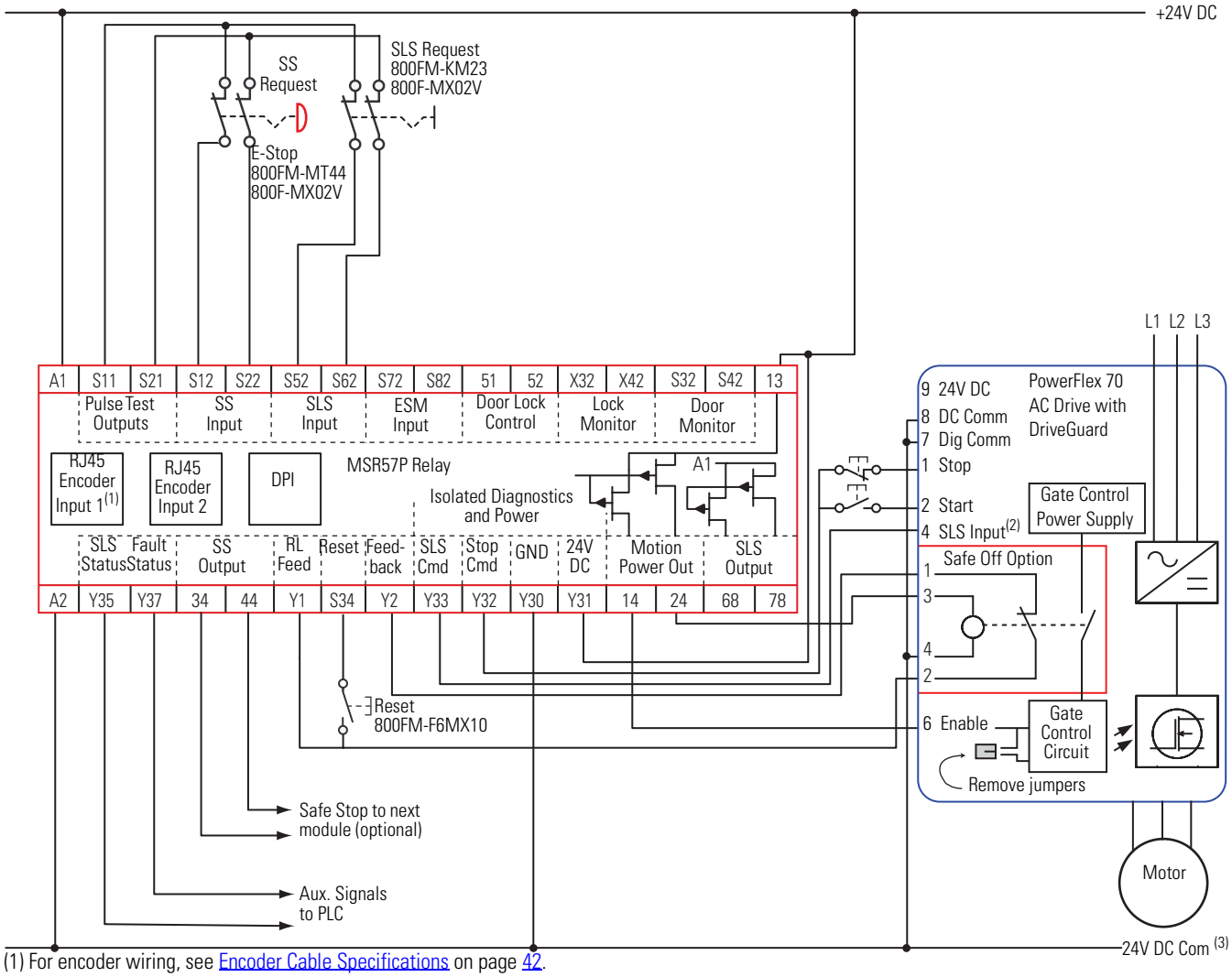
(1) If pulse-testing is turned off for any output, the SIL, Category, and PL rating is reduced for the entire MSR57P safety system.

(2) You must configure this parameter with a non-zero value in this mode.

Safe Limited Speed Wiring Example

This example illustrates safe limited speed wiring.

Master, Safe Limited Speed (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 42.

(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.

(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safe Limited Speed with Door Monitoring Mode

When properly configured for Safe Limited Speed with Door Monitoring, the relay performs Safe Limited Speed (SLS) monitoring functions as described in Safe Limited Speed (SLS) Mode on page 105 in addition to the Safe Stop functions as described in Safe Stop Mode on page 89.

In addition, the speed monitoring relay verifies through monitoring the Door Monitor input (DM_In) that the device controlled by the Door Control output (DC_Out) is in the expected state. If the door is monitored as opened when it should be closed, the speed monitoring relay initiates the configured Safe Stop Type.

The Door Monitor input (DM_In) is ON when the door is closed and OFF when the door is open. The DM_In input must be ON (door closed) whenever Safe Limited Speed monitoring is inactive (SLS_In is ON, meaning the circuit is closed). The DM_In input must also be ON (door closed) during a Safe Limited Speed Monitoring Delay [LimSpd Mon Delay]. A Door Monitor Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

If Safe Limited Speed Monitoring is active (SLS_In input is OFF) and the relay has verified a safe speed condition, the door can be unlocked and opened.

ATTENTION

Make sure that an unlocked door does not result in a hazardous situation.

If a Safe Stop Type is initiated or a fault occurs while the relay is actively monitoring Safe Limited Speed, door control remains unlocked. The safe state of the SLS_In input may allow the door to be unlocked.

You can monitor the door's status with or without the door control (lock/unlock) function. When door control logic is set to lock, it prevents personnel from entering the hazardous area when the machine is not at a safe speed or at Standstill Speed.

Safe Limited Speed Reset

When properly configured for Safe Limited Speed with Door Monitoring, the relay must be monitoring motion (SLS_In input is OFF) if the door is open (DM_In is OFF). Make sure the door is closed before requesting an SLS Reset.

A Safe Limited Speed Reset results in a Door Monitoring Fault if the door is open (DM_In is OFF) when the reset is requested by a transition of the SLS_In input from OFF to ON. A Door Monitor Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

SLS with Door Monitoring Parameter List

To configure the relay for Safe Limited Speed with Door Monitoring, set the DM Input parameter in addition to the Safe Stop parameters listed on page 99 and the Safe Limited Speed parameters listed on page 108.

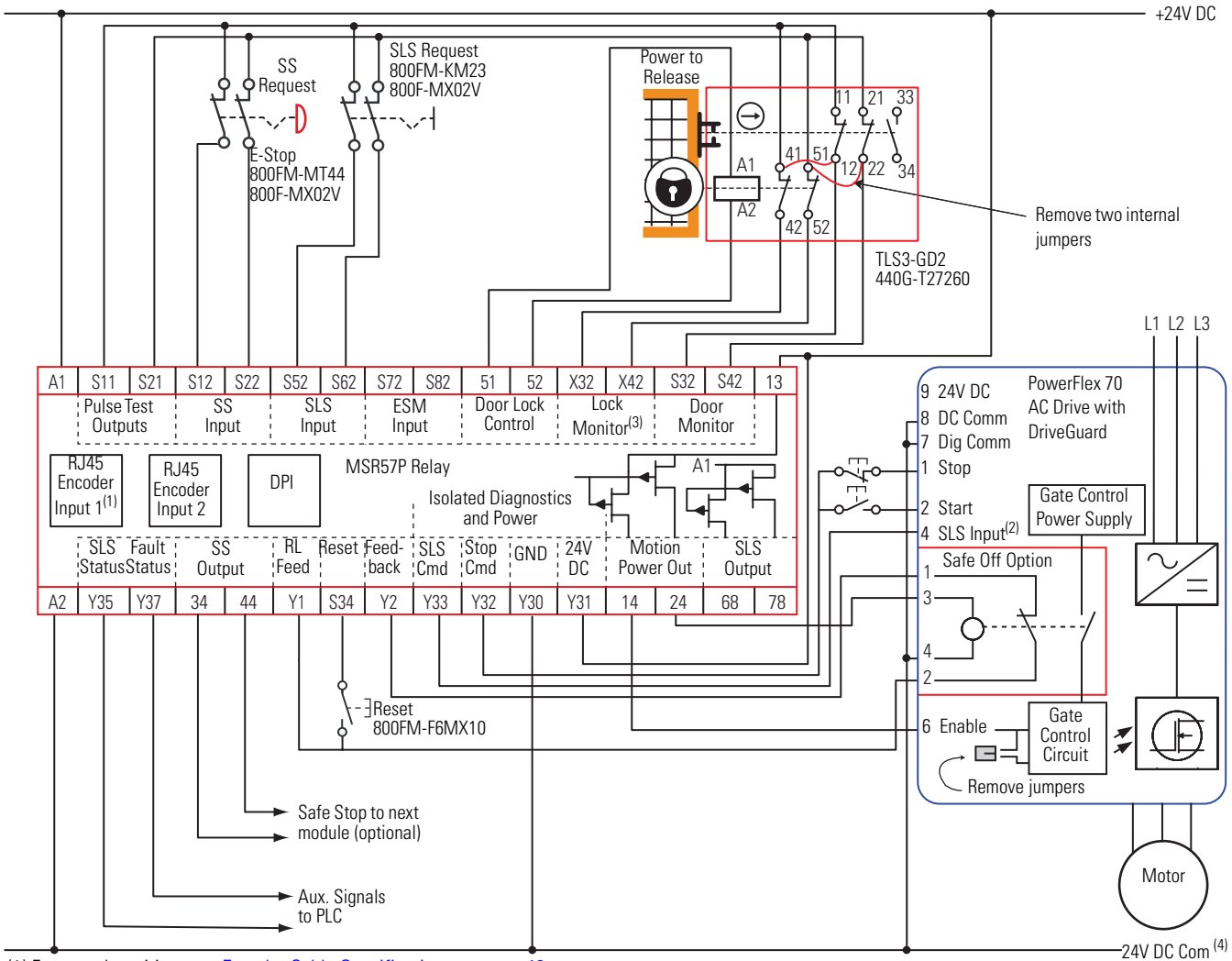
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	4 = Master, Safe Limited Speed with Door Monitoring (Lim Speed DM)
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default:	0 = Not used(1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single-channel equivalent (1NC)

(1) You must configure this parameter with a non-zero value in this mode.

SLS with Door Monitoring Wiring Example

This example illustrates wiring for SLS with door monitoring.

Master, Safe Limited Speed with Door Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safe Limited Speed with Door Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safe Limited Speed with Enabling Switch Monitoring Mode

When properly configured for Safe Limited Speed with Enabling Switch Monitoring, the relay performs Safe Limited Speed (SLS) monitoring functions as described in Safe Limited Speed (SLS) Mode on page 105 in addition to the Safe Stop functions as described in Safe Stop Mode on page 89.

In addition, the relay monitors the Enabling Switch Monitor input (ESM_In) after the Safe Limited Speed Monitoring Delay [LimSpd Mon Delay] times out. The ESM_In input must be ON when the delay times out and Safe Limited Speed monitoring begins, or an ESM Monitoring

Fault occurs. An ESM Monitoring Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

IMPORTANT When Safe Limited Speed Monitoring is inactive, the ESM_In input is not monitored.

Safe Stop Reset (SS Reset) and Safe Limited Speed Reset (SLS Reset)

If an ESM Monitoring Fault occurs due to the ESM_In input turning OFF (enabling switch is released), perform an SLS Reset (cycle the SS_In input) to reset the relay and begin monitoring for Safe Limited Speed again. This is the only case where the SS_In input does not need to be cycled to reset the relay following a fault.

While Safe Limited Speed is being monitored after the SLS Monitoring Delay [LimSpd Mon Delay] times out, if the SLS_In input is ON and an SLS Reset occurs, the ESM_In is not monitored.

ATTENTION

Make sure that the SLS_In input cannot transition to ON while someone is in the hazard area.

Use appropriate procedures when selecting safe limited speed to prevent other users from changing the mode while personnel are in the machine area.

If you attempt an SS Reset when the SLS_In input is OFF and the ESM_In input is OFF, an ESM Monitoring Fault occurs. An ESM Monitoring Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

SLS with Enabling Switch Monitoring Parameter List

To configure the relay for Safe Limited Speed with Enabling Switch Monitoring, set the P54 [Enable SW Input] parameter in addition to the Safe Stop parameters listed on page 99 and the Safe Limited Speed parameters listed on page 108.

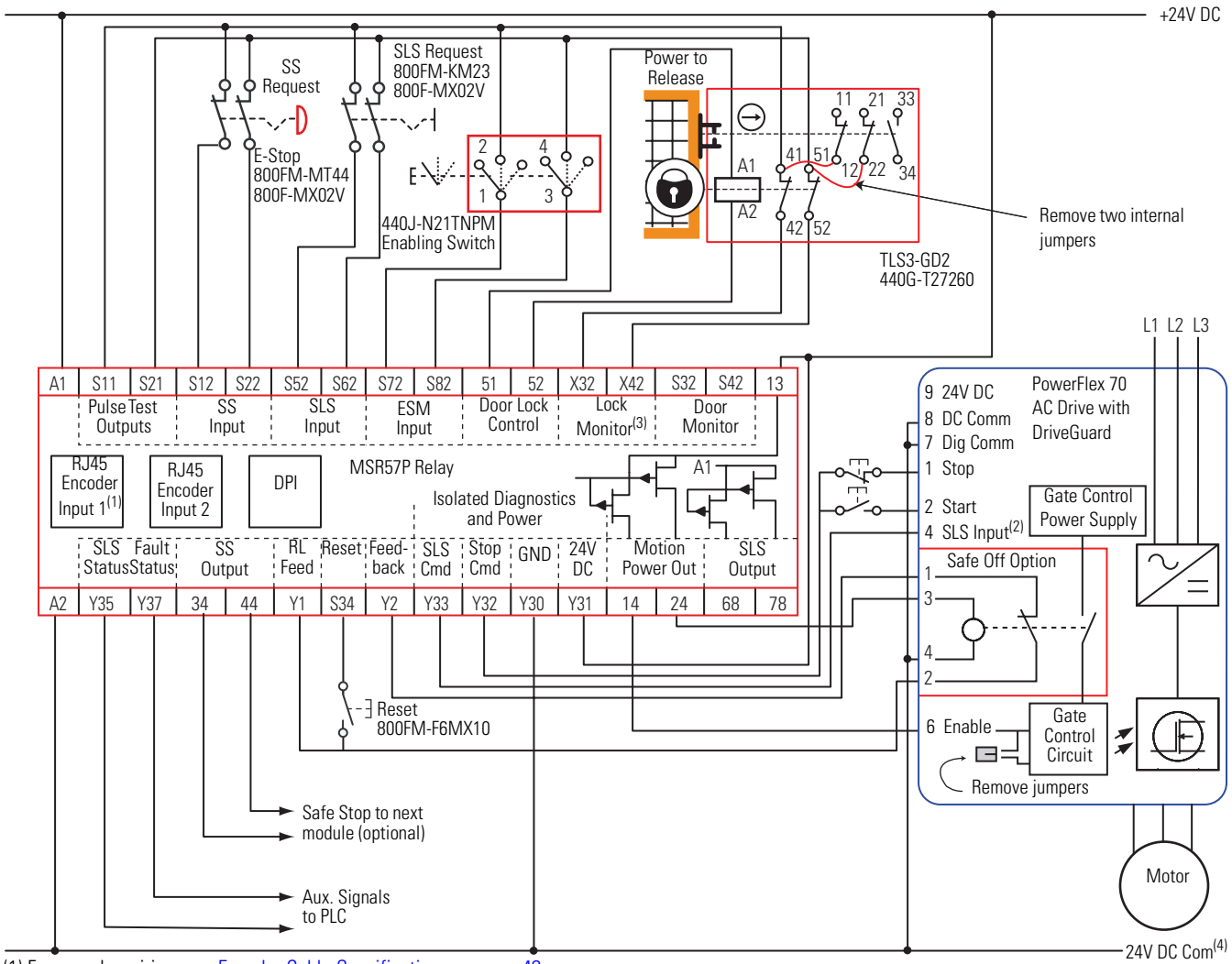
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	5 = Master, Safe Limited Speed with Enabling Switch Control (Lim Speed ES)
54	Enable SW Input	Configuration for the Enabling Switch input (ESM_In).	Default:	0 = Not used(1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single-channel equivalent (1NC)

(1) You must configure this parameter with a non-zero value in this mode.

SLS with Enabling Switch Monitoring Wiring Example

This example illustrates wiring for SLS with enabling switch monitoring.

Master, Safe Limited Speed with Enabling Switch Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safe Limited Speed with Enabling Switch Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring Mode

When properly configured for Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring, the relay performs Safe Limited Speed (SLS) monitoring functions as described on page 105, in addition to the Safe Stop functions as described in Safe Stop Mode on page 89.

The relay also monitors both the Enabling Switch Monitor input (ESM_In) and the Door Monitor input (DM_In).

This mode lets you access the hazardous area when the machine is under a Safe Limited Speed condition. The following is a typical procedure for accessing the hazardous area using this mode.

1. Set the SLS_In input to OFF.

   The Safe Speed Limit must not be exceeded after the Safe Limited Speed Monitoring Delay [LimSpd Mon Delay], if configured, times out.

2. After the Safe Limited Speed Monitoring Delay has timed out, hold the enabling switch in the middle position.

   Once a safe speed is detected and the enabling switch is in the middle position, the relay unlocks the door.

3. Continue to hold the enabling switch while you open the door, enter the hazard area, and perform the required maintenance.

Follow these steps to remove the safe speed condition and resume normal run operation.

1. Leave the hazard area while holding the enabling switch.

2. Hold the enabling switch until the door is closed and you have disabled the SLS_In input by setting it to the ON or closed position.

3. Release the enabling switch.

4. Press the reset button, if manual reset is configured.

   The machine resumes normal run operation.

ATTENTION

Make sure that the SLS_In input cannot transition to ON while someone is in the hazard area.

Use appropriate procedures when selecting safe limited speed to prevent other users from changing the mode while personnel are in the machine area.

Behavior During SLS Monitoring

When Safe Limited Speed monitoring is active, door control logic is set to Unlock if the ESM_In input is ON and the speed is detected at below the Safe Speed Limit.

If the ESM_In input is ON, the door can be opened (DM_In transitions from ON to OFF). However, if the ESM_In input transitions to OFF after the door has been opened, an ESM Monitoring Fault occurs. An ESM Monitoring Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

If the DM_In input transitions from ON to OFF (door is opened), while the ESM_In input is OFF, a Door Monitoring Fault occurs. A Door Monitoring Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

ATTENTION

While Safe Limited Speed Monitoring is active, the ESM_In input is not monitored until the DM_In input is detected as OFF. Make sure that the ESM_In input is not relied upon for safety until the DM_In input has transitioned to OFF.

After the DM_In input turns OFF, it could turn back ON again if the door is closed behind the operator but the ESM_In input is still monitored.

Behavior While SLS Monitoring is Inactive

If Safe Limited Speed monitoring is inactive, the DM_In input must be ON (door closed) or a Door Monitoring Fault occurs and the relay initiates the configured Safe Stop Type. The ESM_In input can be ON or OFF.

Behavior During SLS Monitoring Delay

The status of the ESM_In input does not affect the operation of the system during a Safe Limited Speed Monitoring Delay [LimSpd Mon Delay]. However, the DM_In input must be ON (door closed) during the delay or a Door Monitoring Fault occurs and the relay initiates the configured Safe Stop Type.

Safe Stop Reset (SS Reset) and Safe Limited Speed Reset (SLS Reset)

The door must be closed when an SS Reset or SLS Reset is requested. An SS Reset results in a Door Monitoring Fault if the door is open when the reset is requested by a transition of the SS_In input from OFF to ON. An SLS Reset also results in a Door Monitoring Fault if the door is open when the reset is requested by a transition of the SLS_In input from OFF to ON. A Door Monitor Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

If an SS Reset is attempted while the SLS_In input is OFF, an ESM Monitoring Fault occurs. An ESM Monitoring Fault is a Stop Category Fault, which initiates the configured Safe Stop Type.

SLS with Door Monitoring and Enabling Switch Monitoring Parameter List

To configure the relay for Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring, set the P58 [DM Input] and P54 [ESM Input] parameters in addition to the Safe Stop parameters listed on page 99 and the Safe Limited Speed parameters listed on page 108.

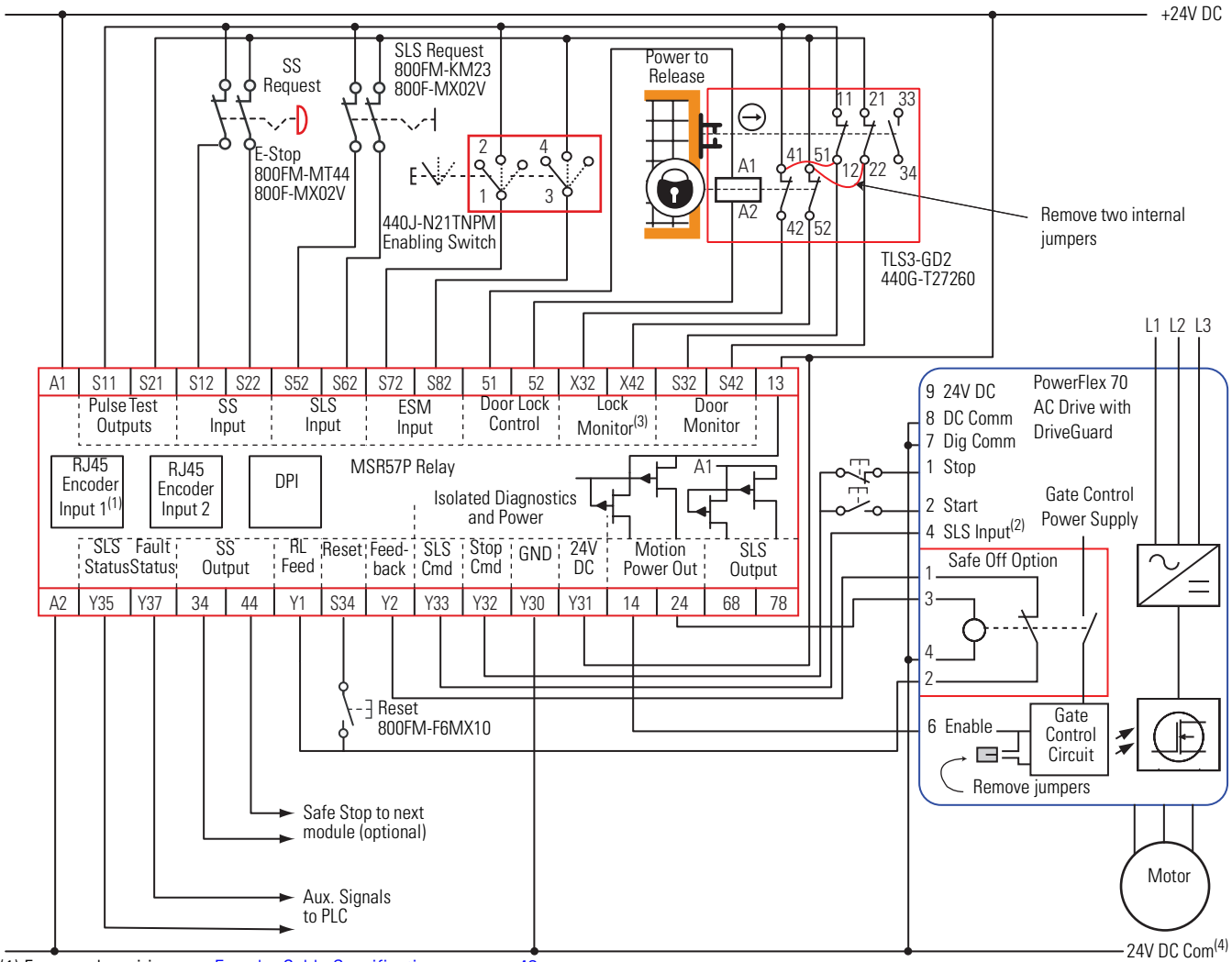
Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	6 = Master, Safe Limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES)
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default:	0 = Not used
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single-channel equivalent (1NC)
54	Enable SW Input	Configuration for the Enabling Switch input (ESM_In).	Default:	0 = Not used(1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single-channel equivalent (1NC)

(1) You must configure this parameter with a non-zero value in this mode.

SLS with Door Monitoring and Enabling Switch Monitoring Wiring Example

This example illustrates wiring for SLS with door monitoring and enabling switch monitoring.

Master, Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring (First or Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(3) Lock monitoring connections are not required for Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring mode operation.
(4) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Safe Limited Speed Status Only Mode

When properly configured for Safe Limited Speed Status Only, the relay provides Safe Limited Speed status information in addition to the Safe Stop functions as described in Safe Stop Mode on page 89.

When the Safe Limited Speed input (SLS_In) is OFF, the feedback velocity is monitored and compared against a configurable Safe Speed Limit. If the measured velocity exceeds the limit, no stopping action

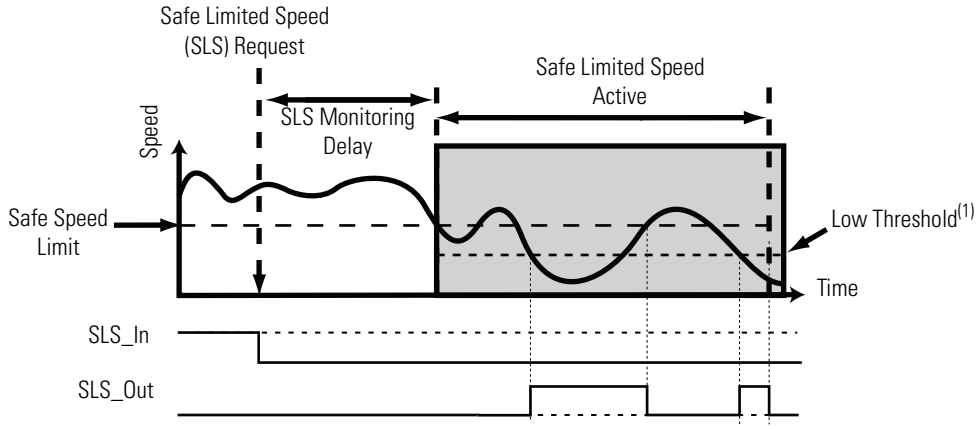
takes place. Instead the system status is made available as a safe output intended for a safety programmable logic controller (PLC). You can program an optional Safe Limited Speed Monitoring Delay [Lim Spd Mon Delay] to delay the start of Safe Limited Speed monitoring. In this mode, Door Monitoring and Enabling Switch Monitoring are not available.

ATTENTION

When the relay is properly configured for Safe Limited Speed Status Only mode, it will not automatically initiate a Safe Stop in the event of an overspeed condition.

Safe Limited Speed monitoring is requested by a transition of the SLS_In input from ON to OFF. If you configure a Safe Limited Speed Monitoring Delay, the delay begins when Safe Limited Speed monitoring is requested by the SLS_In input transition from ON to OFF. The relay begins monitoring for Safe Limited Speed when the delay times out. The SLS_Out output is ON if Safe Limited Speed monitoring is active and the speed is below the configured Safe Speed Limit, considering hysteresis.

Timing Diagram for Safe Limited Speed Status Only



(1) Low Threshold = (Speed Hysteresis/100) x Safe Speed Limit

Speed Hysteresis

The P56 [Speed Hysteresis] parameter provides hysteresis for the SLS_Out output when the relay is configured for SLS Status Only and Safe Limited Speed monitoring is active. The SLS_Out output is turned ON if the speed is less than the Low Threshold, which equals {(Speed Hysteresis/100) x Safe Speed Limit}. The SLS_Out output is turned OFF

when the speed is greater than or equal to the configured Safe Speed Limit.

The SLS_Out output remains OFF if Safe Limited Speed monitoring begins when the detected speed is less than the configured Safe Speed Limit but greater than or equal to the Low Threshold {(Speed Hysteresis/100) x Safe Speed Limit}.

The SLS_Out output is held in its last state when the speed is less than the configured Safe Speed Limit and the speed is greater than or equal to the Low Threshold {(Speed Hysteresis/100) x Safe Speed Limit}.

SLS Status Only Parameter List

To configure the relay for Safe Limited Speed Status Only monitoring, set these parameters in addition to the Safe Stop parameters listed on page 99.

Parameter		Description	Setting	
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Setting:	7 = Master, Safe Limited Speed Status Only (Lim Spd Stat)
52	Lim Speed Input	Configuration for the Safe Limited Speed input (SLS_In).	Default:	0 = Not used(1)
			Options:	0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single-channel equivalent (1NC)
53	LimSpd Mon Delay	Defines the Safe Limited Speed Monitoring Delay between the SLS_In ON to OFF transition and the initiation of the Safe Limited Speed (SLS) monitoring.	Default:	0
			Range:	0...6553.5 s
55	Safe Speed Limit	Defines the speed limit that will be monitored during the Safe Limited Speed (SLS) mode.	Default:	0
			Range:	0...6555.3 rpm or mm/s based on rotary or linear configuration defined by the encoder 1 feedback configuration P29 [Fbk 1 Units] parameter
56	Speed Hysteresis	Provides hysteresis for SLS_Out output when safe limited speed monitoring is active.	Default:	0(2)
			Range:	10...100%

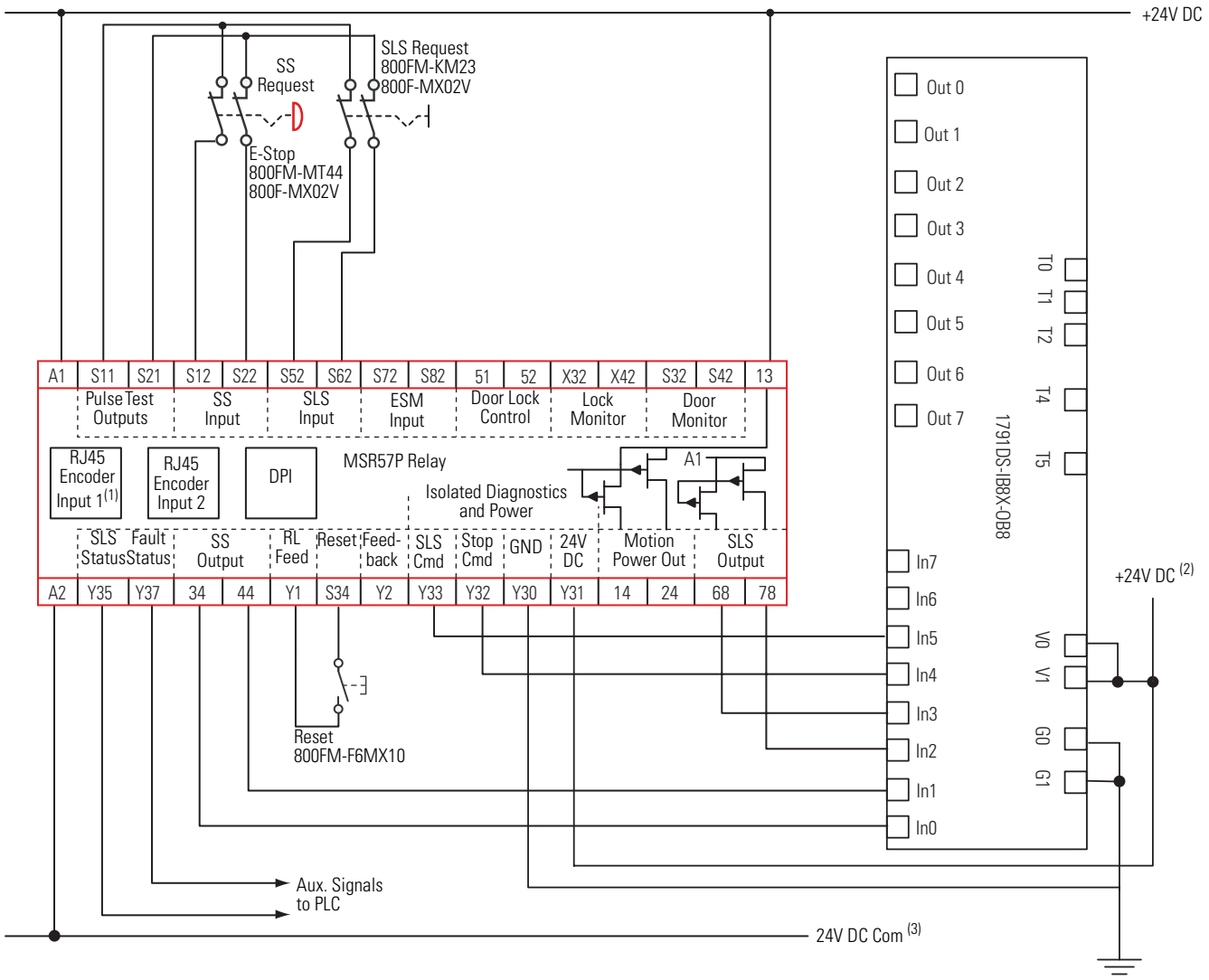
(1) You must configure this parameter with a non-zero value in this mode.

(2) You must configure this parameter with a value in the range from 10…100% in this mode.

SLS Status Only Wiring Examples

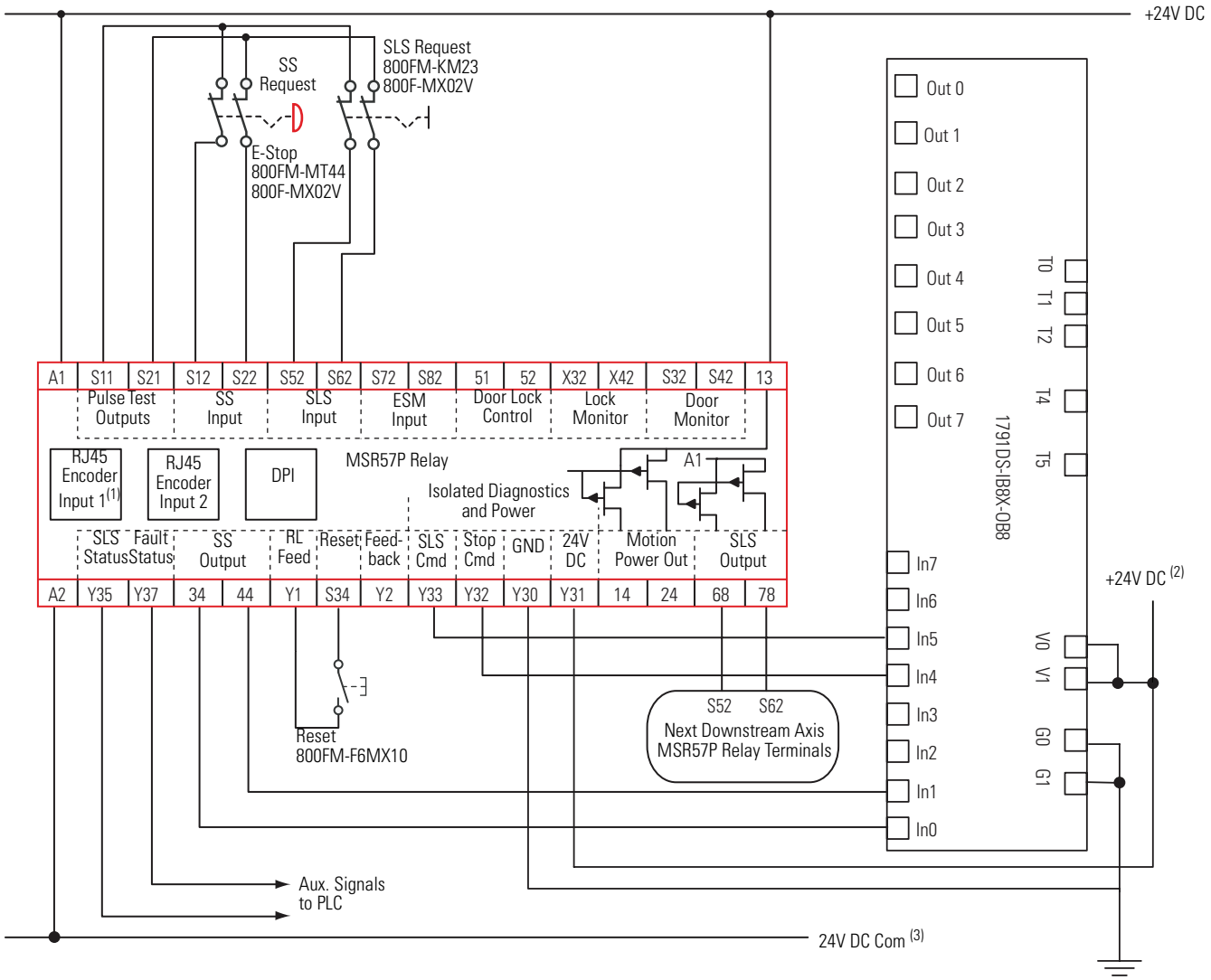
These examples illustrate wiring for SLS Status Only operation.

Master, Safe Limited Speed Status Only (Single Unit)



(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Power supply may or may not be isolated.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Master, Safe Limited Speed Status Only (First Unit)



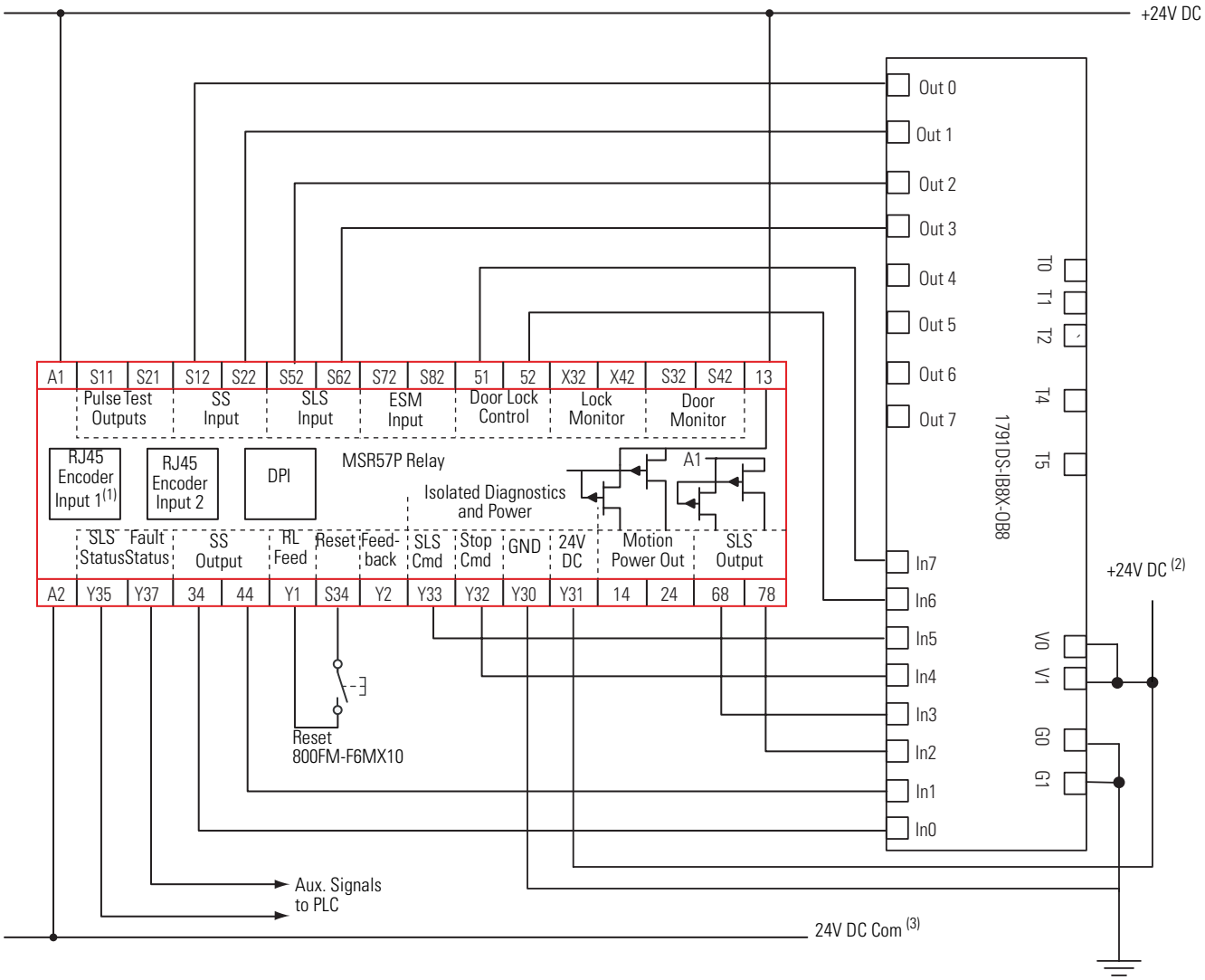
(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Power supply may or may not be isolated.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

This example assumes that a programmable safety controller is monitoring all MSR57P relay functions and controlling the relay. The SS_In and SLS_In inputs are connected to the I/O module; however, standard safety component inputs could also be used.

These functions are not performed by the MSR57P in the this scenario.

- Guardlocking switch inputs
- Door locking
- Door status (open or closed)
- Enabling switch

Safe Limited Speed Status Only with Programmable Controller Monitoring



(1) For encoder wiring, see Encoder Cable Specifications on page 42.
(2) Power supply may or may not be isolated.
(3) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Slave Modes for Multi-axis Cascaded Systems

Introduction

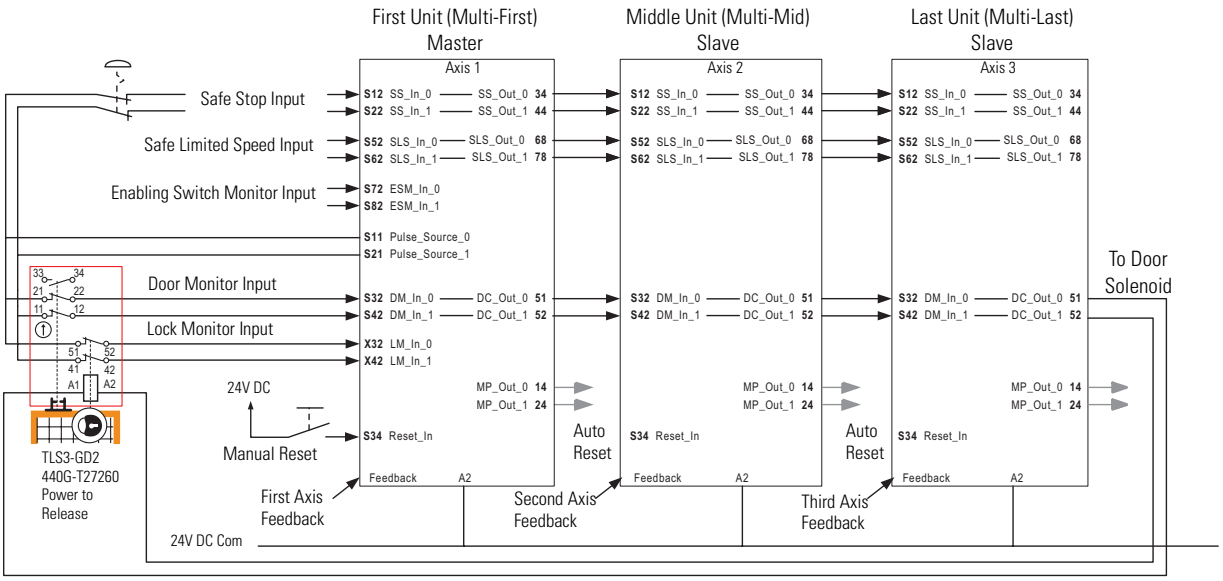
Topic	Page
Cascaded Configurations	125
Slave, Safe Stop Mode	127
Slave, Safe Stop Parameter List	127
Slave, Safe Stop Wiring Examples	129
Slave, Safe Limited Speed Mode	132
Slave, Safe Limited Speed Parameters	132
Slave, Safe Limited Speed Wiring Examples	133
Slave, Safe Limited Speed Status Only Mode	135
Slave, Safe Limited Speed Status Only Parameter List	135
Slave, Safe Limited Speed Status Only Wiring Examples	135
Multi-axis Connections	137
Cascaded System Examples	139

Cascaded Configurations

Only the middle or last relays in a multi-axis system can be configured for slave modes. Use the P20 [Cascaded Config] parameter to define the relay's position in the system as Single Unit (Single), Cascaded First Unit (Multi First), Cascaded Middle Unit (Multi Mid), or Cascaded Last Unit (Multi Last).

For cascaded speed monitoring safety relays, connect the safety switches to the safety inputs (SS_In, SLS_In, DM_In, ESM_In, and LM_In) of the first (master) axis only. Each feedback and the Motion Power output (MP_Out) for Safe Stop functions are connected to their respective axis. The inputs are cascaded from one relay to the next by connecting the outputs from the previous relay to the inputs of the next relay.

Cascaded Connections



The inputs from the safety switches are monitored by the first relay, which is the master. A Safe Limited Speed Reset detected by the first relay is cascaded to the subsequent relays via the SLS_Out to SLS_In chain. Although all MSR57P units can be configured for any reset type, we recommend using automatic reset in all slave units to follow the master units reset type.

Any fault or transition of the SS_In input to OFF is detected by the first relay and initiates the configured Safe Stop Type to all of the relays via the SS_Out to SS_In chain.

Any fault in a slave relay only initiates the configured Safe Stop Type to that relay and to slave relays further down the chain.

IMPORTANT Safe Stop monitoring is not initiated for non-faulted relays earlier in the cascaded chain.

IMPORTANT The safety reaction time for a cascaded system includes the sum of the reaction times of each relay in the chain.

Slave, Safe Stop Mode

When properly configured for Slave, Safe Stop mode, the speed monitoring safety relay performs the same functions as Safe Stop except that the relay regards the Door Monitor input as a Door Control output from an upstream axis, and performs a logical AND with its internal Door Control signal to form the cascaded Door Control output. This makes sure that the Door Control output only commands the door to unlock if all units command the door to unlock.

Slave, Safe Stop Parameter List

To configure the relay for a Slave, Safe Stop mode, set these parameters. See Multi-axis Connections on page 137 for details on configuring slave relays.

Slave, Safe Stop Parameters

Parameter		Description	Setting
20	Cascaded Config	Defines whether the speed monitoring relay is a single unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Options: 2 = Cascaded middle unit (Multi Mid) 3 = Cascaded last unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Option: 8 = Slave, Safe Stop (Slv Safe Stop)
44	Safe Stop Input	Configuration for Safe Stop input (SS_In).	Option: 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s)
45	Safe Stop Type	Safe operating stop type selection. This defines the type of Safe Stop that is performed if the Safe Stop function is initiated by a stop type condition.	Default: 0 = Safe Torque Off with Standstill Checking (Torque Off) Options: 0 = Safe Torque Off with Standstill Checking (Torque Off) 1 = Safe Stop 1 2 = Safe Stop 2 3 = Safe Torque Off without Standstill Checking (Trq Off NoChk)
46	Stop Mon Delay	Defines the monitoring delay between the request for a Safe Stop and the start of the Stop Delay [Max Stop Time] when the request for a Safe Stop 1 or a Safe Stop 2 is initiated by an SS_In input ON to OFF transition. If the Safe Stop Type is Safe Torque Off with or without Speed Checking, the Stop Monitoring Delay must be 0 or an Invalid Configuration Fault occurs.	Default: 0 Range: 0...6553.5 s
47	Max Stop Time	Defines the maximum stop delay time that is used when the safe stop function is initiated by a stop type condition.	Default: 0 Range: 0...6553.5 s
48	Standstill Speed	Defines the speed limit that is used to declare motion as stopped. Not valid for Safe Torque Off without Standstill Speed Checking.	Default: 0.001 Range: 0.001...65.535 rpm or mm/s based on rotary or linear configuration defined by encoder 1 feedback configuration P29 [Fbk 1 Units] parameter

Slave, Safe Stop Parameters

Parameter		Description	Setting
49	Standstill Pos	Standstill Position Window. Defines the position limit in encoder 1 degrees or mm that will be tolerated after a Safe Stop condition has been detected.	Default: 10 Range: 0...65,535 degrees (360° = 1 revolution) or mm based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
50	Decel Ref Speed	Decel Reference Speed. Determines deceleration rate to monitor for Safe Stop 1 or Safe Stop 2.	Default: 0 Range: 0...65,535 rpm or mm/s based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
51	Stop Decel Tol	Decel Tolerance. This is the acceptable tolerance above the deceleration rate set by the P50 [Decel Ref Speed] parameter.	Default: 0 Range: 0...100% of Decel Ref Speed
57	Door Out Type	Door Control Output Type. Defines the lock and unlock state for door control output (DC_Out). The first and middle units of a multi-axis system must be configured as cascading (2).	Default: 0 = Power to release (Pwr to Rel) Options: 0 = Power to release (Pwr to Rel) 1 = Power to lock (Pwr to Lock) 2 = Cascaded (2 Ch Sourcing)
58	DM Input Type	Door Monitor Input Type. Configuration for the door monitor input (DM_In).	Option: 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s)

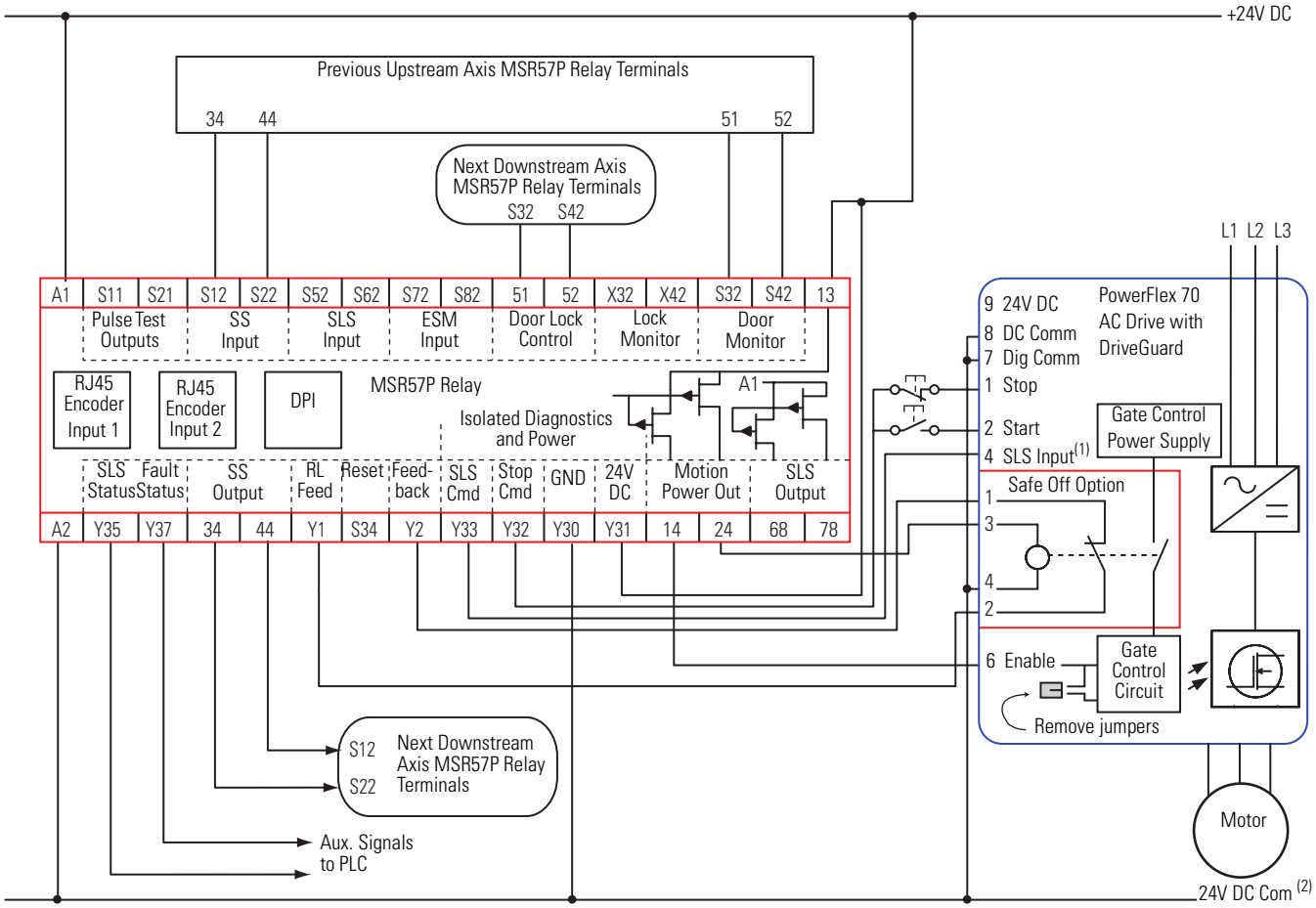
Slave, Safe Stop Wiring Examples

The examples on the following pages show two different Slave, Safe Stop configurations.

The first example shows an MSR57P configured as a cascaded middle unit via the P20 [Cascaded Config] parameter (Multi Mid). It has SS_In and DM_In input connections from the previous upstream MSR57P relay, as well as SS_Out and DC_Out output connections to the next downstream MSR57P relay. This unit is configured with automatic reset so it follows the function of the previous axis.

See Safe Stop with Door Monitoring Wiring Example on page 104 for an example of a first (master) unit.

Slave, Safe Stop, Middle Unit

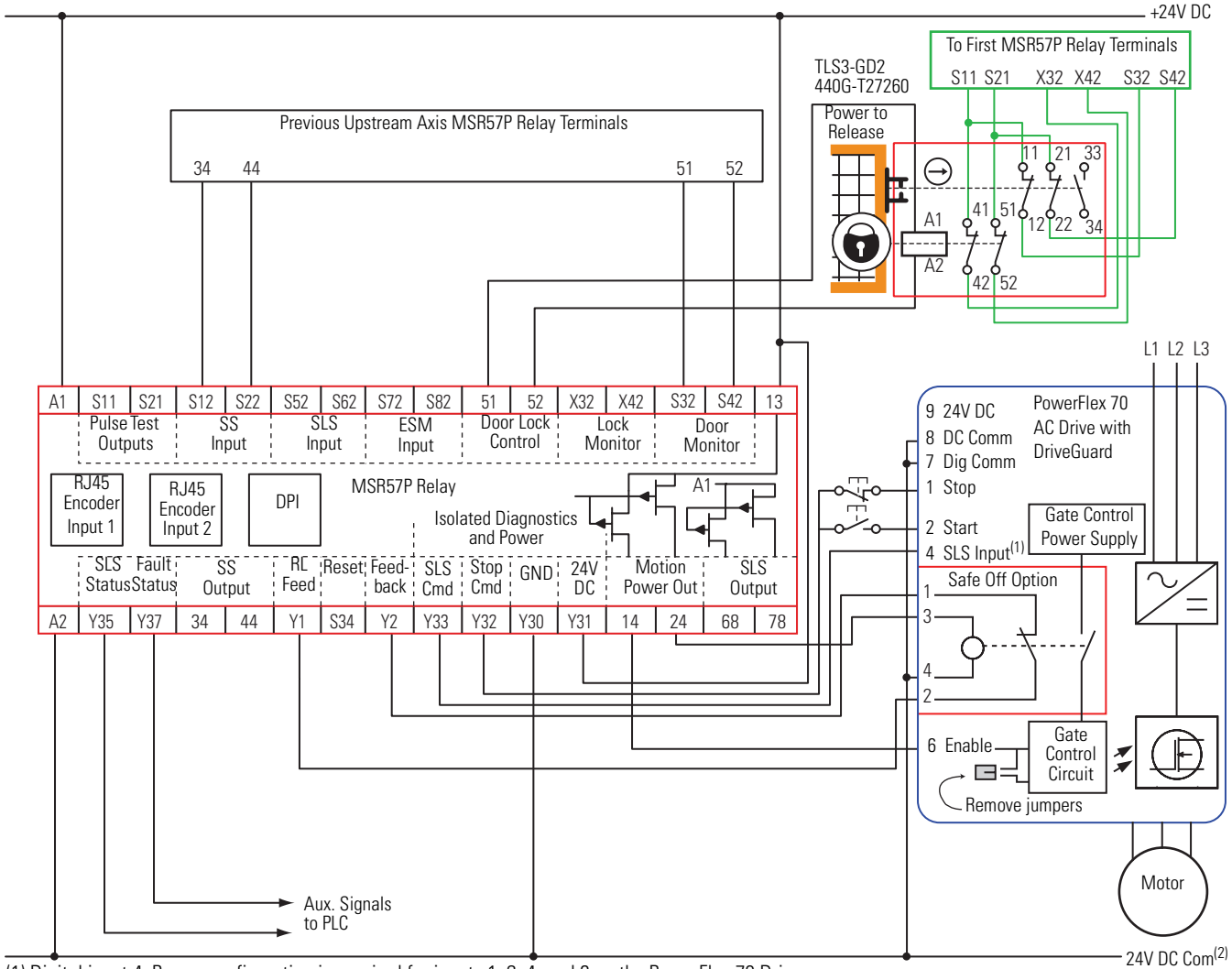


(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.

(2) All cascaded MSR57P units must share a common ground. 24V DC Com must be at the same potential as the drive common because of the encoder signal.

This example shows the last cascaded slave relay in the system. It has SS_In and DM_In inputs from the previous upstream MSR57P relay, but its DC_Out output is connected to a guardlocking interlock switch. This unit is configured with automatic reset so it follows the function of the previous axis.

Slave, Safe Stop, Last Unit

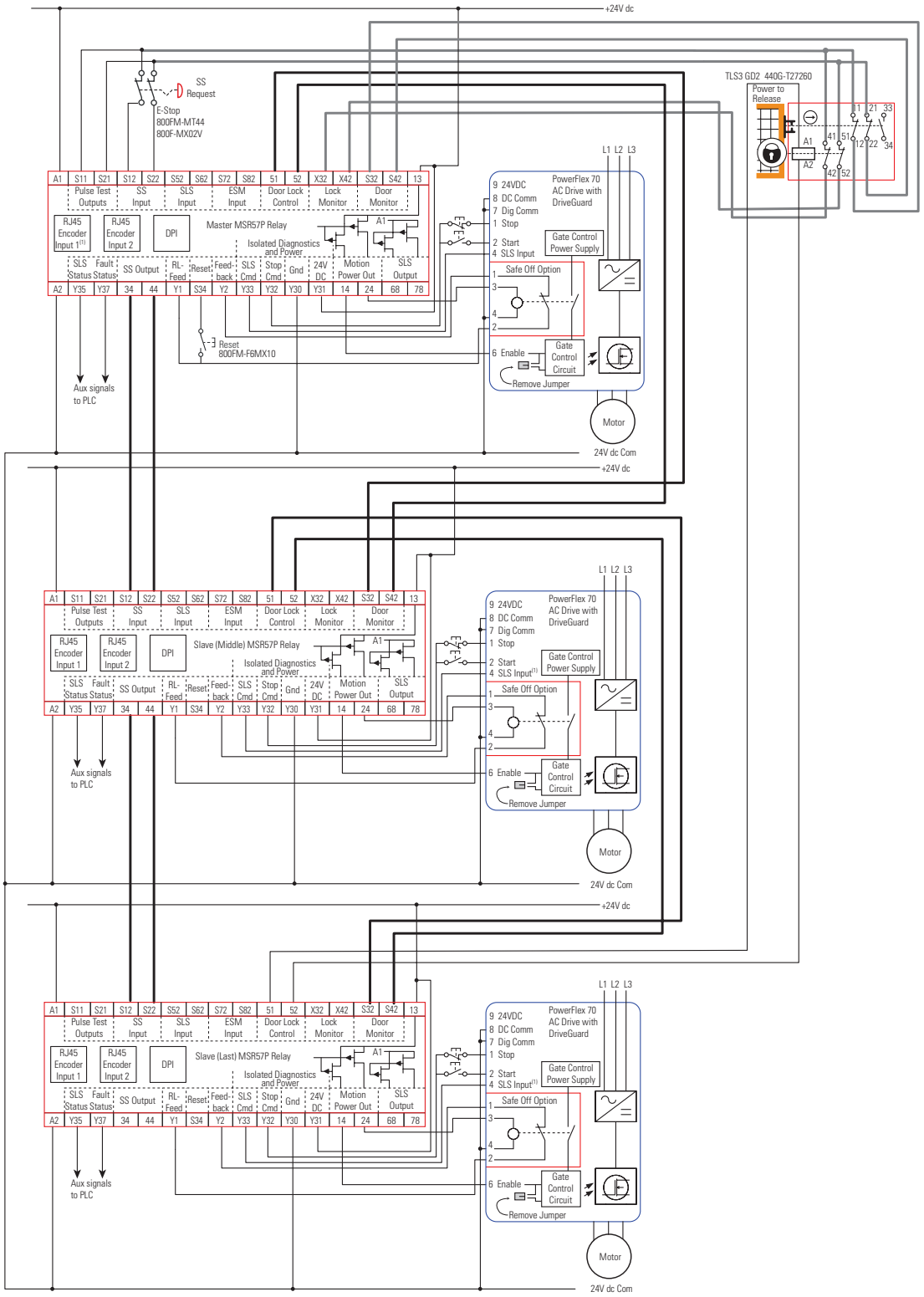


(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.

(2) All cascaded MSR57P units must share a common ground. 24V DC Com must be at the same potential as the drive common because of the encoder signal.

This example shows three relays connected together in a cascaded system. All relays must have a shared common ground.

First, Middle, and Last Relays in a Cascaded System with Door Control and Lock Monitoring



Slave, Safe Limited Speed Mode

When properly configured for Slave, Safe Limited Speed mode, the speed monitoring safety relay performs the same functions as Safe Limited Speed mode as described on page 105.

However, the relay regards the Door Monitor input as a Door Control output from an upstream axis, and performs a logical AND with its internal Door Control signal to form the cascaded Door Control output. Door Monitoring, Enabling Switch Monitoring, and Lock Monitoring functions are not allowed in this mode.

For the door to unlock, all axes must be below safe limited speed.

TIP Only the middle and last relays in a multi-axis system can be configured for slave modes.

Slave, Safe Limited Speed Parameters

To configure the relay for Slave, Safe Limited Speed monitoring, set these parameters in addition to the Slave, Safe Stop parameters listed on page 127. See Multi-axis Connections on page 137 for details on configuring slave relays.

Parameter		Description	Setting
20	Cascaded Config	Defines whether the speed monitoring relay is a single unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Options: 2 = Cascaded middle unit (Multi Mid) 3 = Cascaded last unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Option: 9 = Slave, Safe Limited Speed (Slv Lim Spd)
52	Lim Speed Input	Configuration for the Safe Limited Speed input (SLS_In).	Option: 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s)
53	LimSpd Mon Delay	Defines the Safe Limited Speed Monitoring Delay between the SLS_In ON to OFF transition and the initiation of the Safe Limited Speed (SLS) monitoring.	Default: 0 Range: 0...6553.5 s
55	Safe Speed Limit	Defines the speed limit that will be monitored during the Safe Limited Speed (SLS) mode.	Default: 0(1) Range: 0...6553.5 rpm or mm/s based on rotary or linear configuration defined by the encoder 1 feedback configuration P29 [Fbk 1 Units] parameter

(1) You must configure a value greater than zero for this parameter in this mode.

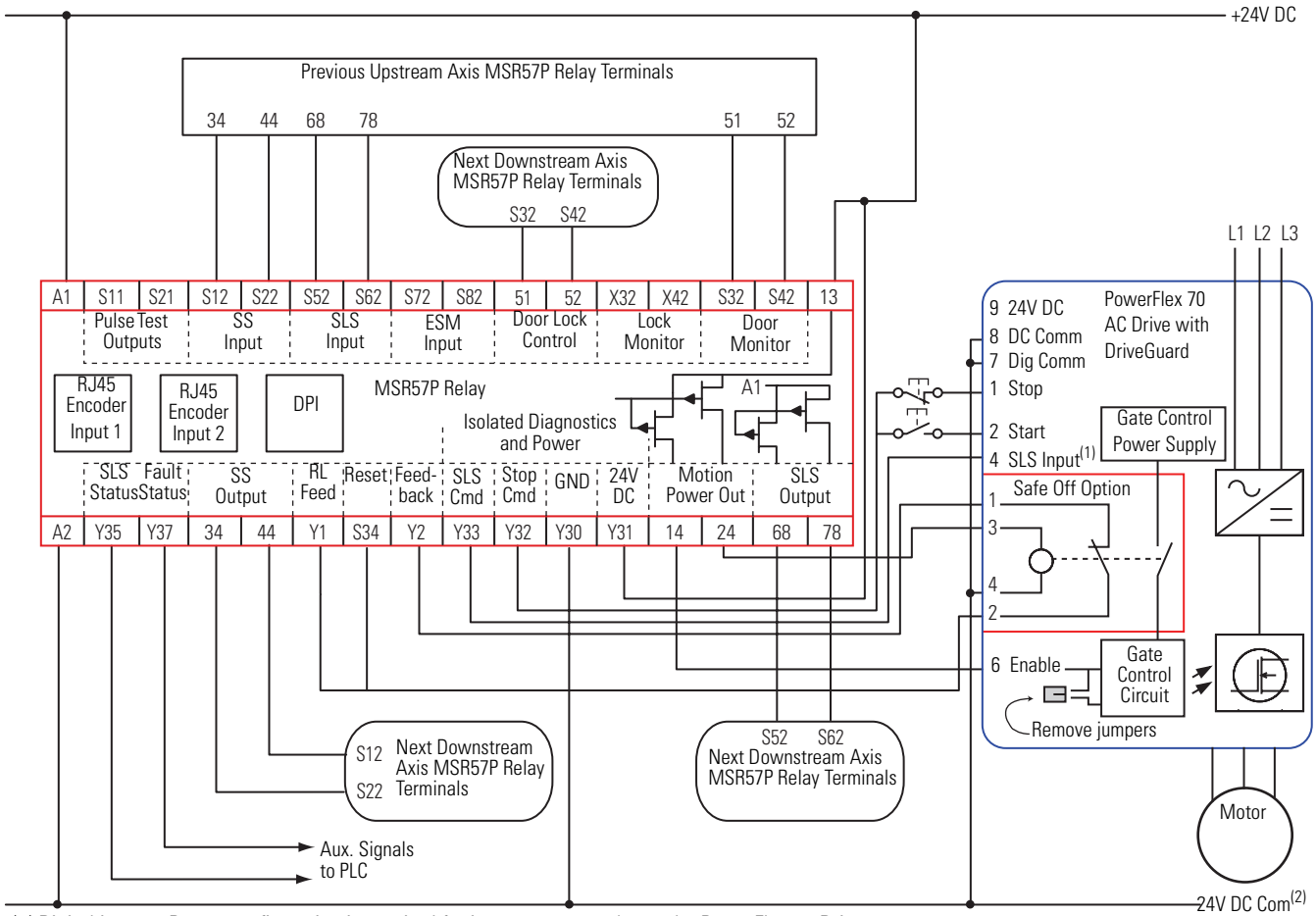
Slave, Safe Limited Speed Wiring Examples

These examples shows two different Slave, Safe Limited Speed configurations.

The first example is configured as a cascaded middle unit via the P20 [Cascaded Config] parameter (Multi Mid). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P relay, as well as SS_Out, SLS_Out, and DC_Out output connections to the next downstream MSR57P relay.

See SLS with Door Monitoring Wiring Example on page 112 for an example of a first (master) unit.

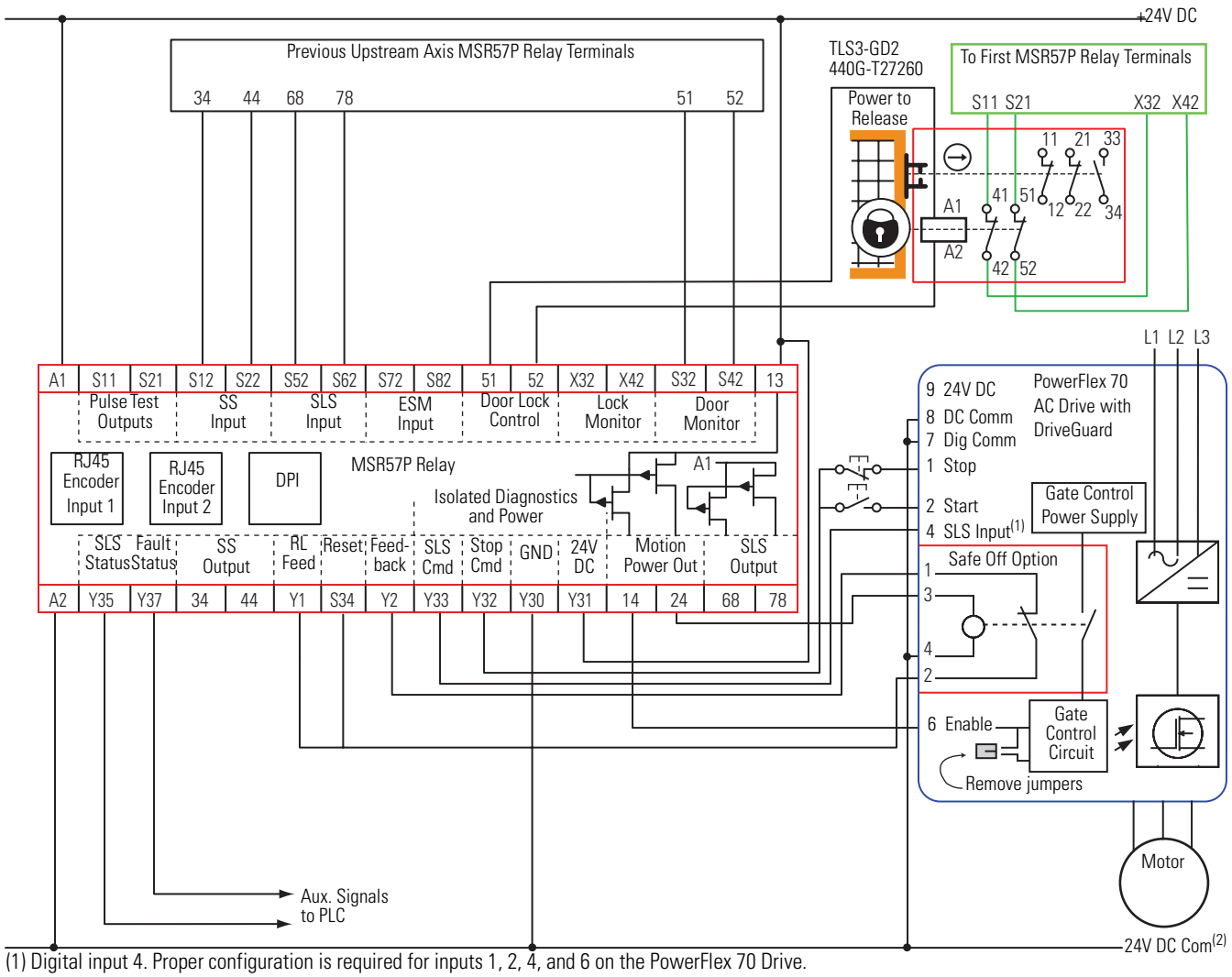
Slave, Safe Limited Speed, Middle Unit



(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.
(2) All cascaded MSR57P units must share a common ground.24V DC Com must be at the same potential as the drive common because of the encoder signal.

This second example is configured as a cascaded last unit via the P20 [Cascaded Config] parameter (Multi Last). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P relay, but its DC_Out output is connected to a guardlocking interlock switch.

Slave, Safe Limited Speed, Last Unit



(1) Digital input 4. Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.

(2) All cascaded MSR57P units must share a common ground. 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Slave, Safe Limited Speed Status Only Mode

When properly configured for Slave, Safe Limited Speed Status Only mode, the speed monitoring safety relay performs the same functions as Safe Limited Speed Status Only mode as described on page 119. However, the relay regards the Door Monitor input as a Door Control output from an upstream axis, and performs a logical AND with its internal Door Control signal to form the cascaded Door Control output.

The SLS_Out output of the last MSR57P in a cascaded chain only goes high when all axes are below the Safe Speed Limit. In Safe Limited Speed Status Only mode, each subsequent unit does not enable Safe Limited Speed until the previous unit has reached the Safe Speed Limit.

Door Monitoring and Enabling Switch Monitoring functions are not allowed in this mode.

TIP Only the middle and last relays in a multi-axis system can be configured for slave modes.

Slave, Safe Limited Speed Status Only Parameter List

To configure the relay for Slave, Safe Limited Speed Status Only monitoring, set these parameters in addition to the Slave, Safe Stop parameters listed on page 127 and the Slave, Safe Limited Speed parameters listed on page 132. See Multi-axis Connections on page 137 for details on configuring slave relays.

Parameter		Description	Setting
20	Cascaded Config	Defines whether the speed monitoring relay is a single unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Options: 2 = Cascaded system middle unit (Multi Mid) 3 = Cascaded system last unit (Multi Last)
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety relay.	Option: 10 = Slave, Safe Limited Speed Status Only (Slv Spd Stat)
56	Speed Hysteresis	Provides hysteresis for SLS_Out output when Safe Limited Speed monitoring is active.	Default: 0 Range: 10...100%

Slave, Safe Limited Speed Status Only Wiring Examples

These examples show two different Slave, Safe Limited Speed Status Only configurations.

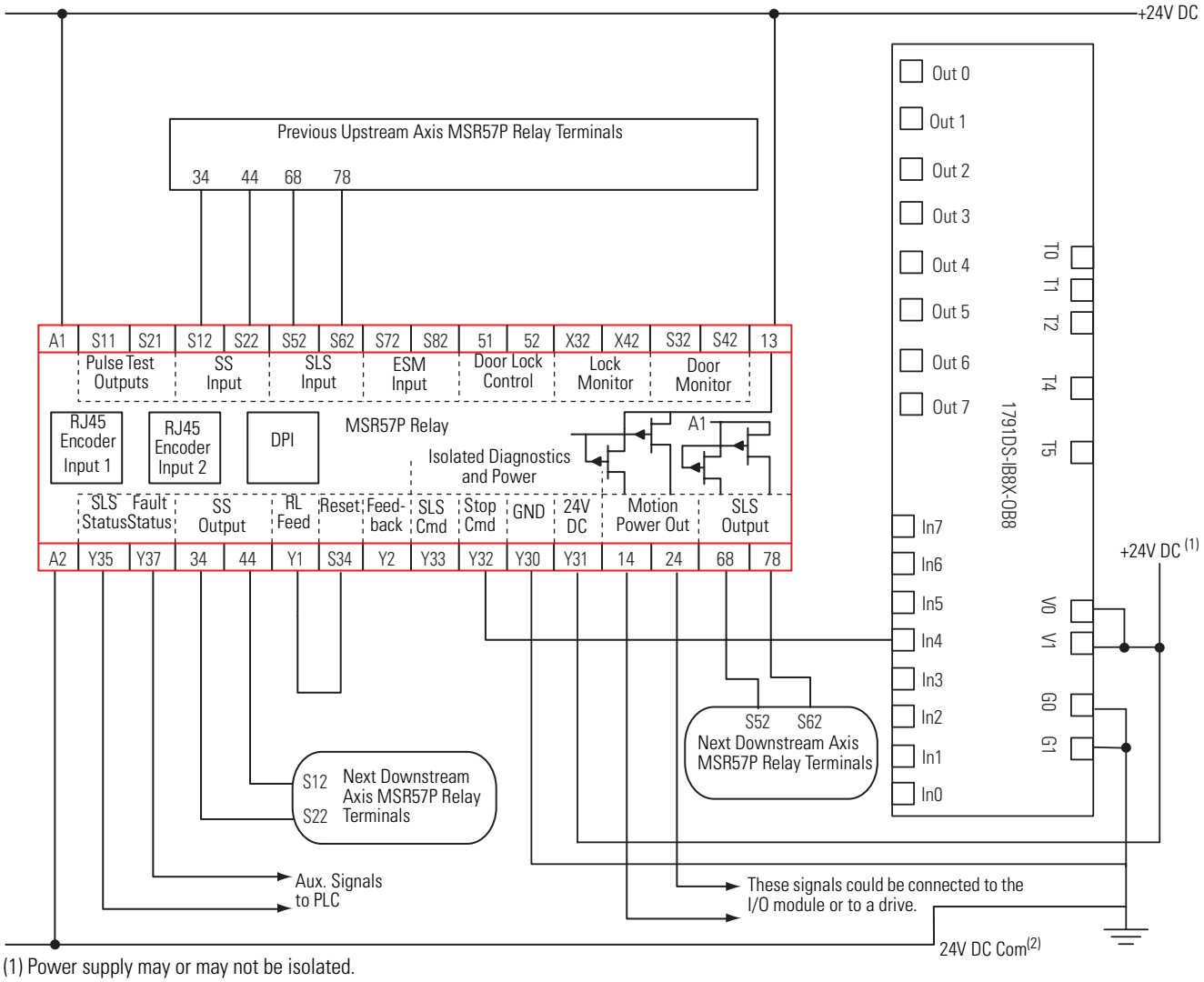
The first example is configured as a cascaded middle unit via the P20 [Cascaded Config] parameter (Multi Mid). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P relay, as well as SS_Out, SLS_Out, and DC_Out output connections to the

next downstream MSR57P relay. SLS Command and Stop Command outputs are connected to a 1791DS module.

IMPORTANT The SLS_Out signals change state immediately based on the speed relative to the Safe Speed Limit if the Safe Limited Speed Monitoring Delay [Lim Spd Mon Delay] is set to zero.

See SLS Status Only Wiring Examples starting on page 122 for an example of a first (master) unit.

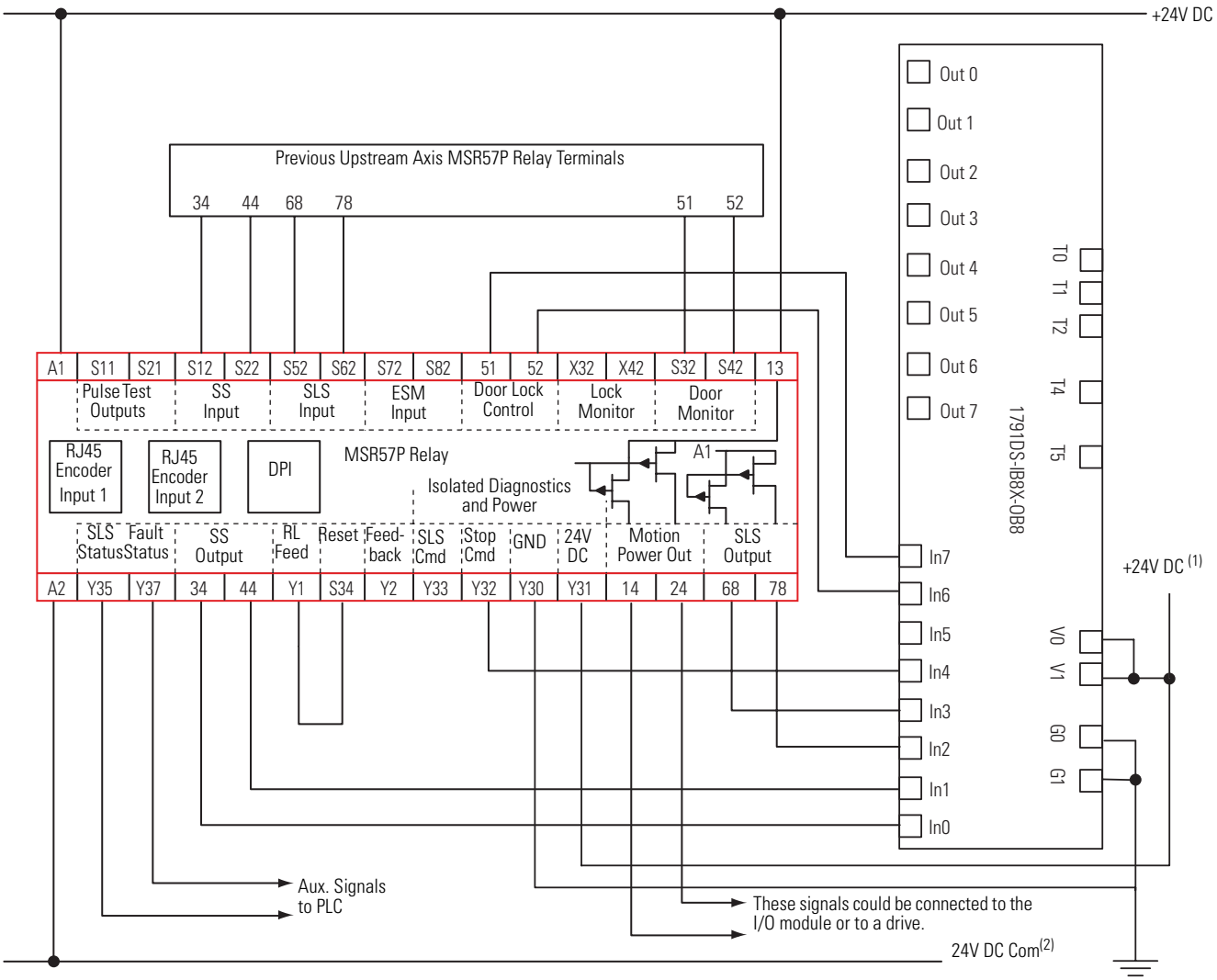
Slave, Safe Limited Speed Status Only, Middle Relay



(1) Power supply may or may not be isolated.
(2) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

This second example is configured as a cascaded last unit via the P20 [Cascaded Config] parameter (Multi Last). It has SS_In, SLS_In, and DM_In input connections from the previous upstream MSR57P relay, but its SS_Out, SLS_Out, and Door Lock Control outputs are connected to a 1791DS module.

Slave, Safe Limited Speed Status Only, Last relay



(1) Power supply may or may not be isolated.
(2) 24V DC Com must be at the same potential as the drive common because of the encoder signal.

Multi-axis Connections

When configuring a multi-axis system, you need to consider each relay's location in the system. The type of cascaded connections that can be made are dependent upon the Safety Mode configurations of the master and slave relays and their positions in the system.

Middle and last relays in the cascaded chain may be configured for Automatic reset. A single reset by the first unit also resets all following units in the chain. If a fault occurs after the first axis in the cascaded chain, only the subsequent axis enters the safe state. To reset all axes, you must cycle the SS_In input on the first axis.

For slave relays in a multi-axis system, the SS_In, SLS_In, and DM_In input signal types (if used) must be configured for output switching signal devices (OSSD) because the output from the previous MSR57P is also configured for OSSD.

For middle or last relays in multi-axis systems, the relay regards the Door Monitor input as a Door Control output from an upstream axis, and performs a logical AND with its internal Door Control signal to form the cascaded Door Control output.

For information on door control in the master relay, see Door Control on page 97.

Safety Mode Combinations for Master and First Slave relays

Typical Safety Mode Combinations		Cascaded Connections Allowed		
Master Relay	**First Slave Relay(1) (Second Relay in System)**	**SS_Out to SS_In**	**SLS_Out to SLS_In**	**DC_Out to DM_In(2)**
Safe Stop	Slave - Safe Stop	Yes	—	Yes
Safe Stop with Door Monitoring	Slave - Safe Stop	Yes	—	Yes
Safe Limited Speed	Slave - Safe Stop	Yes	—	Yes
	Slave - Safe Limited Speed	Yes	Yes	Yes
Safe Limited Speed with Door Monitoring	Slave - Safe Stop	Yes	—	Yes
	Slave - Safe Limited Speed	Yes	Yes	Yes
Safe Limited Speed with Enabling Switch Monitoring	Slave - Safe Stop	Yes	—	Yes
	Slave - Safe Limited Speed	Yes	Yes	Yes
Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring	Slave - Safe Stop	Yes	—	Yes
	Slave - Safe Limited Speed	Yes	Yes	Yes
Safe Limited Speed Status Only	Slave - Safe Stop	Yes	Yes	Yes
	Slave - Safe Limited Speed Status Only	Yes	Yes	Yes

(1) P20 [Cascaded Config] parameter equals Cascaded Middle Unit (Multi Mid).
(2) DC_Out to DM_In connections are only required for systems implementing door control.

The table shows the supported Safety Modes for slave relays (*n*+1) cascaded from slaves (*n*).

Safety Mode Combinations for Cascaded (Middle and Last) Slave Relays

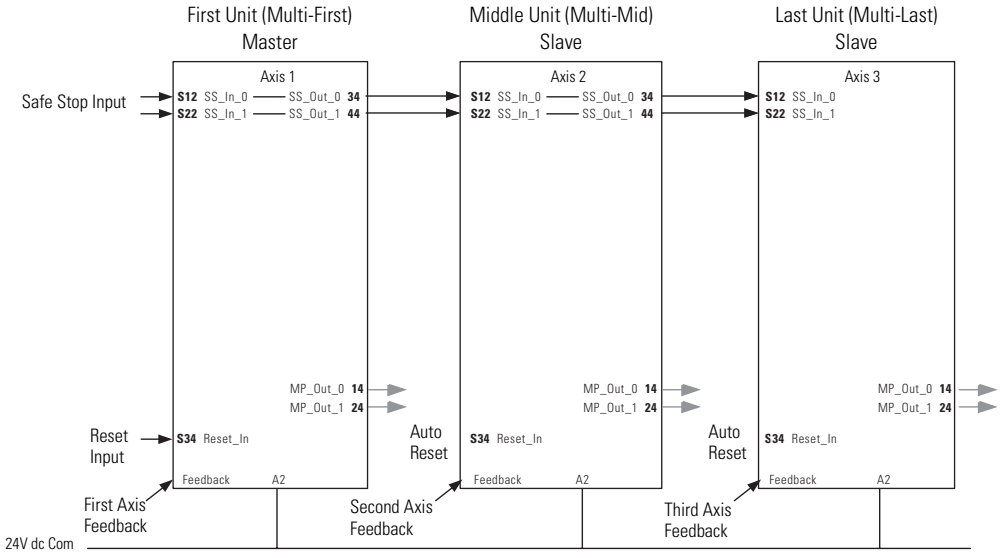
Supported Safety Mode Combinations		Cascaded Connections Allowed		
Slave Relay (*n*)	**Slave Relay (*n*+1)**	**SS_Out to SS_In**	**SLS_Out to SLS_In**	**DC_Out to DM_In(1)**
Slave - Safe Stop	Slave - Safe Stop	Yes	—	Yes
Slave - Safe Limited Speed	Slave - Safe Stop	Yes	—	Yes
	Slave - Safe Limited Speed	Yes	Yes	Yes
Slave - Safe Limited Speed Status Only	Slave - Safe Stop	Yes	—	Yes
	Slave - Safe Limited Speed Status Only	Yes	Yes	Yes

(1) DC_Out to DM_In connections are only required for systems implementing door control.

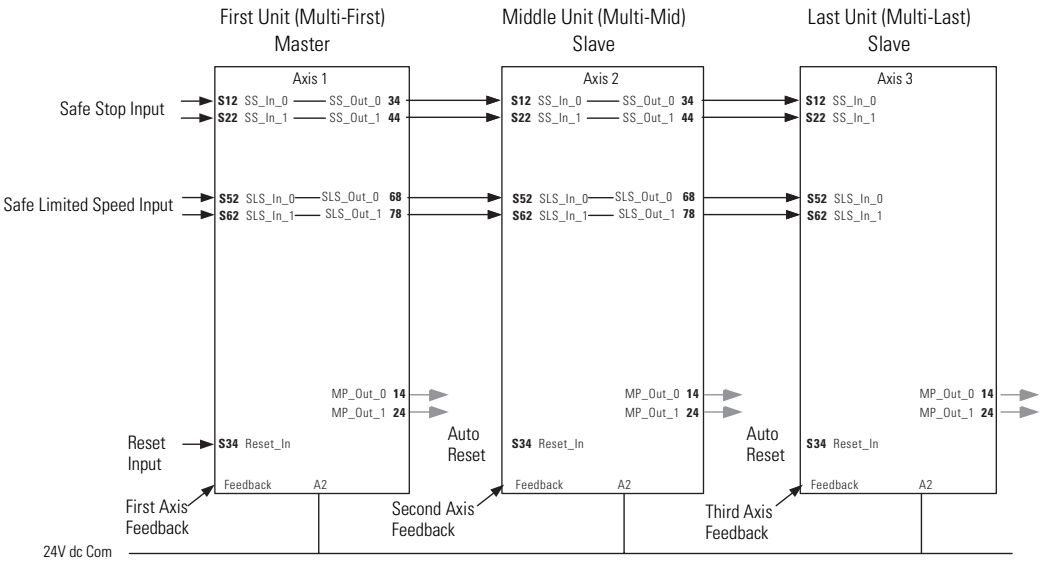
Cascaded System Examples

The following illustrations show a variety of possible cascaded configurations.

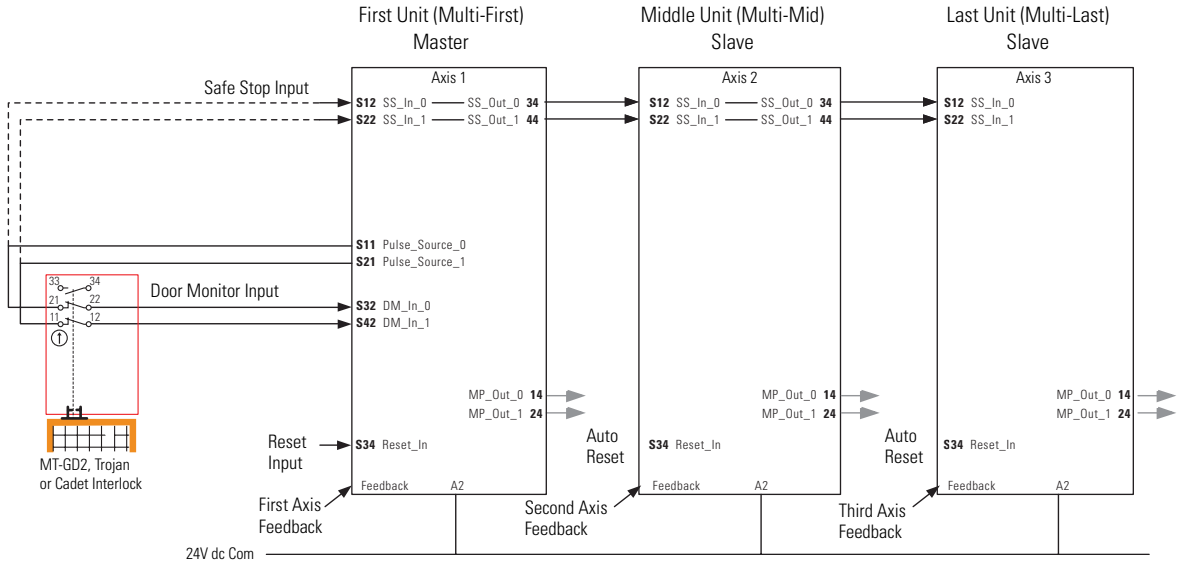
Safe Stop Only (3-wire) Connections



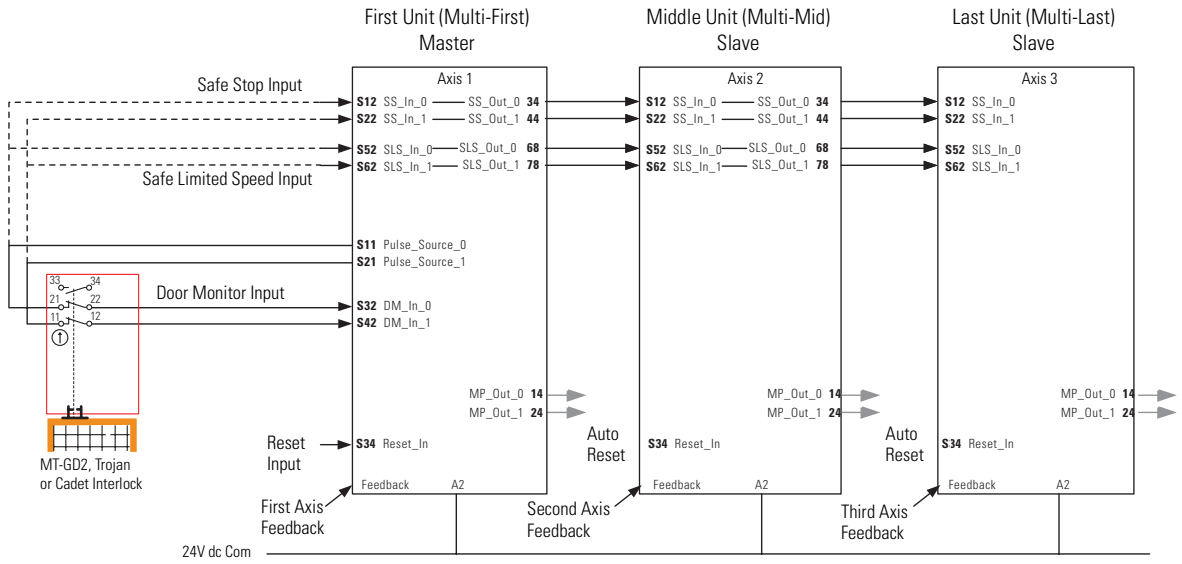
Safe Stop and Safe Limited Speed (5-wire) Connections



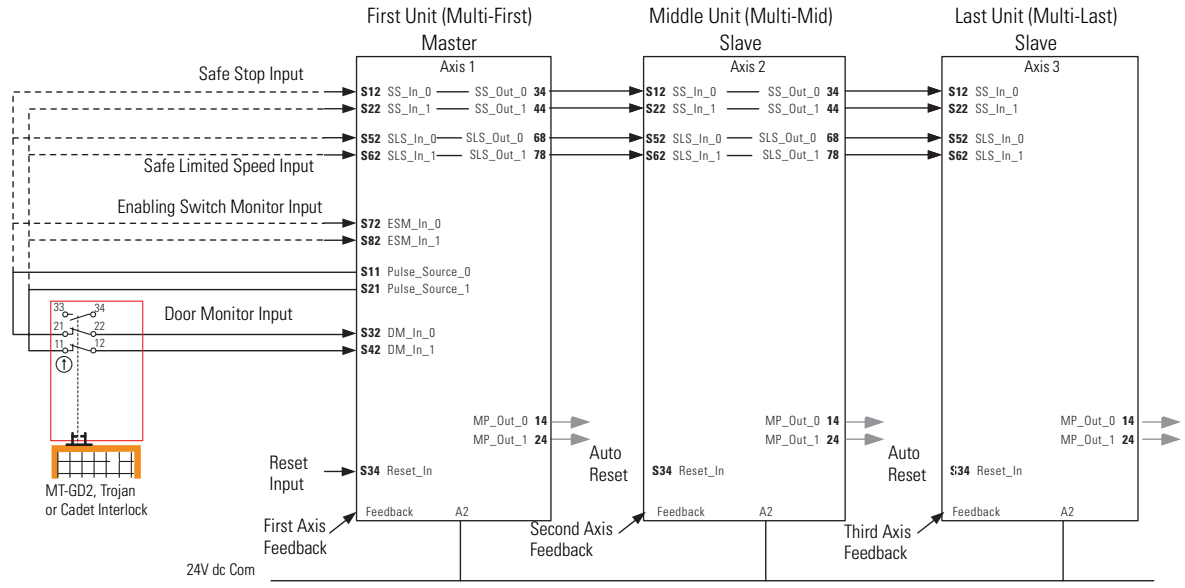
Safe Stop with Door Monitoring (3-wire) Connections



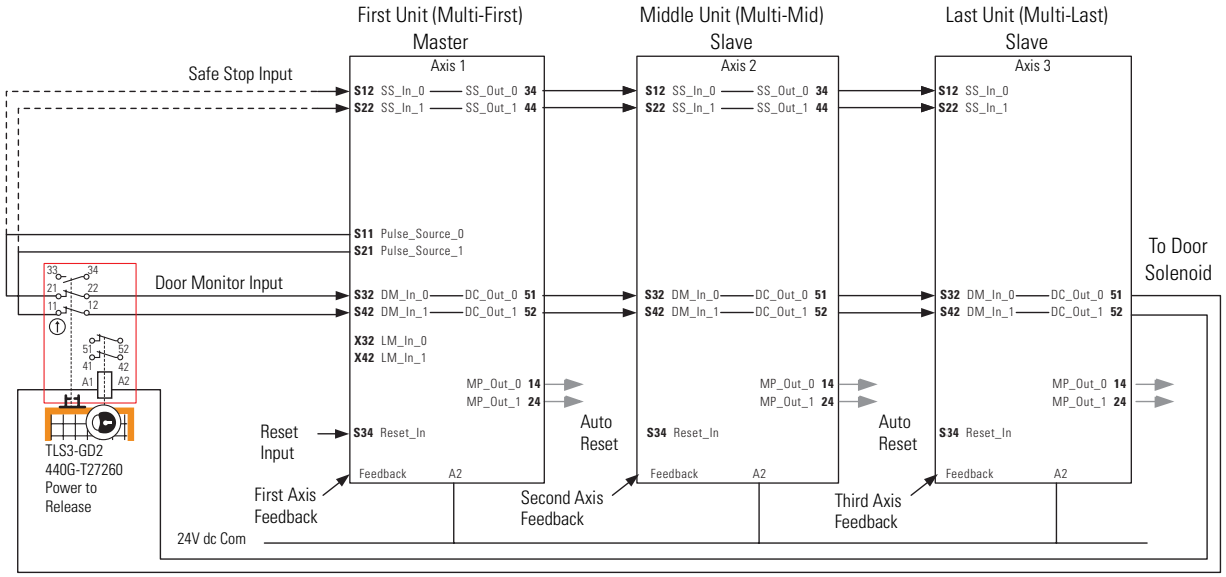
Safe Stop and Safe Limited Speed with Door Monitoring (5-wire) Connections



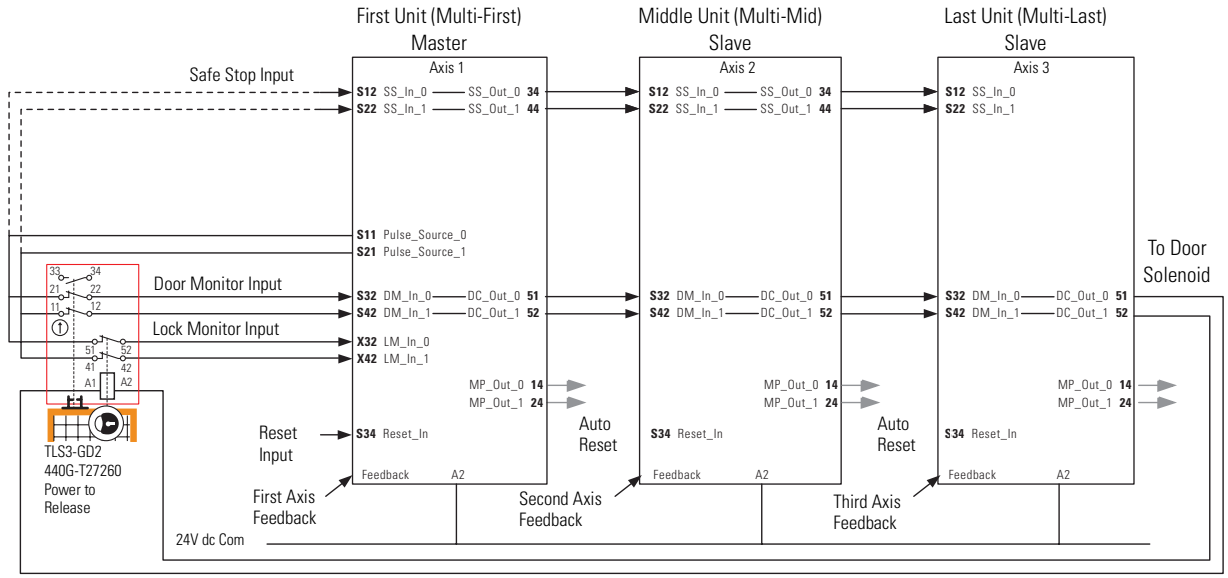
Safe Stop, Safe Limited Speed, and Enabling Switch with Door Monitoring (5-wire) Connections



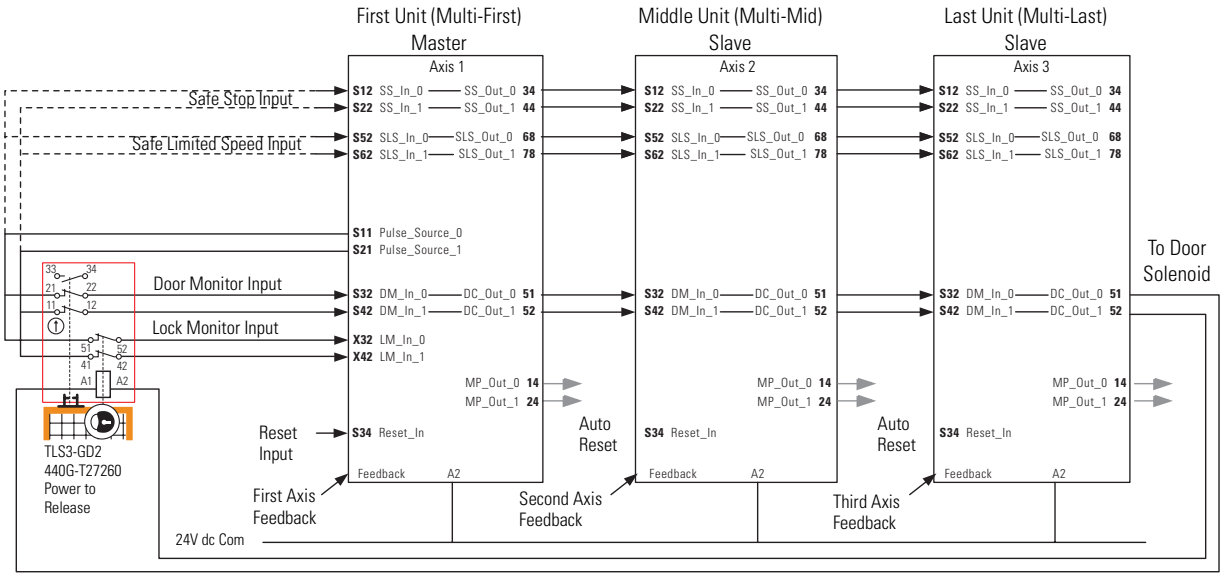
Safe Stop with Door Monitoring and Door Control (5 + 2-wire) Connections



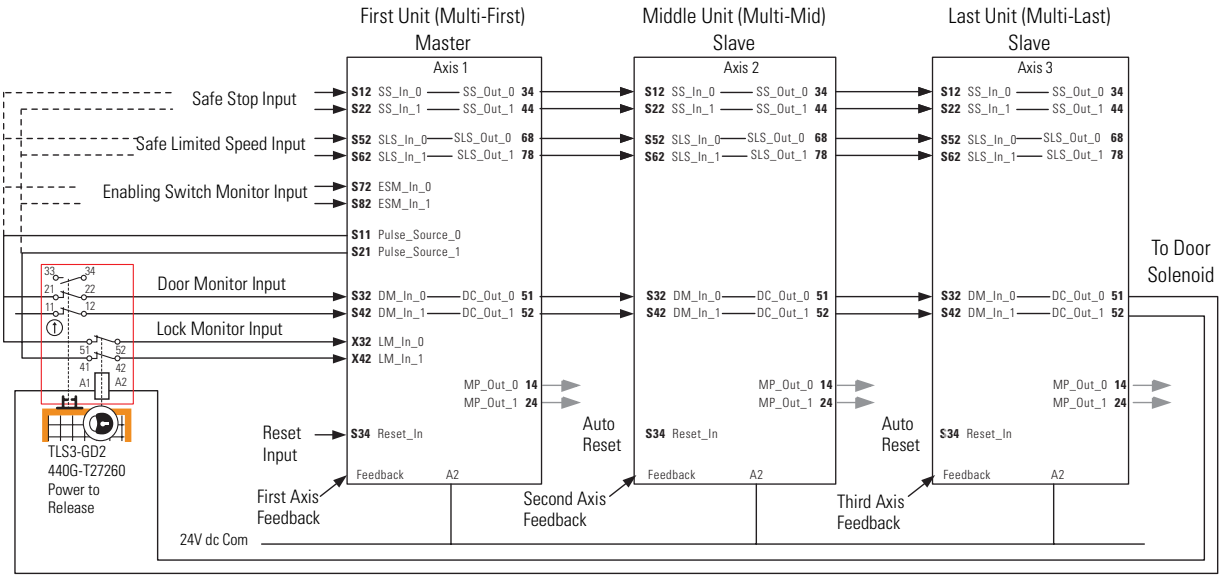
Safe Stop with Door Monitoring, Door Control, and Lock Monitoring (5+2-wire) Connections



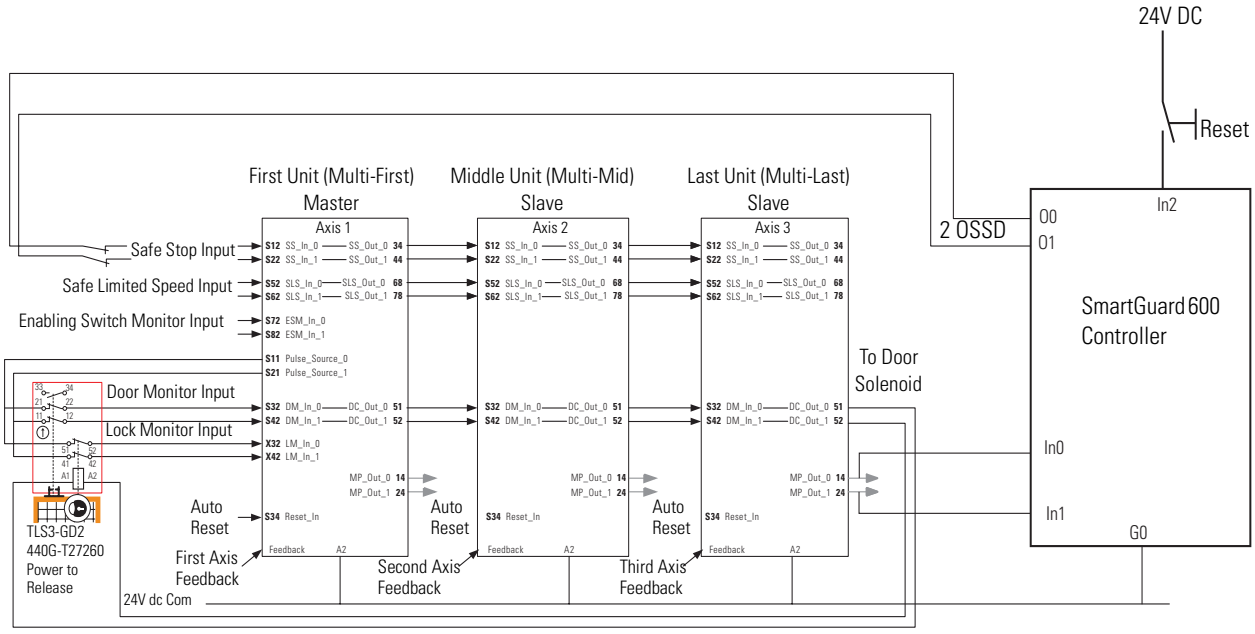
Safe Stop and Safe Limited Speed with Door Monitoring, Door Control, and Lock Monitoring (7 + 2-wire) Connections



Safe Stop, Safe Limited Speed, and Enabling Switch with Door Monitoring, Door Control and Lock Monitoring (7 + 2-wire) Connections



Safe Stop with Door Monitoring, Safe Limited Speed, Lock Monitoring, and Enabling Switch (7 + 2-wire) Connections



This example shows reset control performed by the SmartGuard 600 controller. Any fault on any axis shuts down the entire system. The reset is controlled by the SmartGuard 600 controller.

Safe Maximum Speed and Direction Monitoring

Introduction

Topic	Page
Safe Maximum Speed (SMS) Monitoring	145
Safe Maximum Acceleration (SMA) Monitoring	148
Safe Direction Monitoring (SDM)	150
Max Speed, Max Accel, and Direction Monitoring Parameter List	151

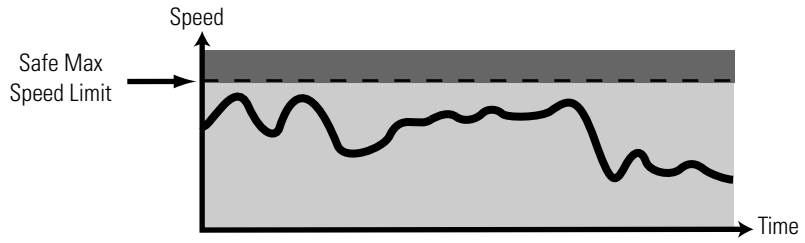
Safe Maximum Speed (SMS) Monitoring

Configure Safe Maximum Speed monitoring by setting the P61 [Max Speed Enable] parameter to Enable. When configured, Safe Maximum Speed monitoring is active any time the relay configuration is valid and Safety Mode is not Disabled.

When you configure the relay for Safe Maximum Speed, the feedback velocity is monitored and compared against a user-configurable limit.

You set the Safe Max Speed Limit, which is relative to encoder 1. If the monitored speed is greater than or equal to the configured Safe Max Speed Limit, an SMS Speed Fault (Stop Category Fault) occurs.

Safe Max Speed Timing Diagram



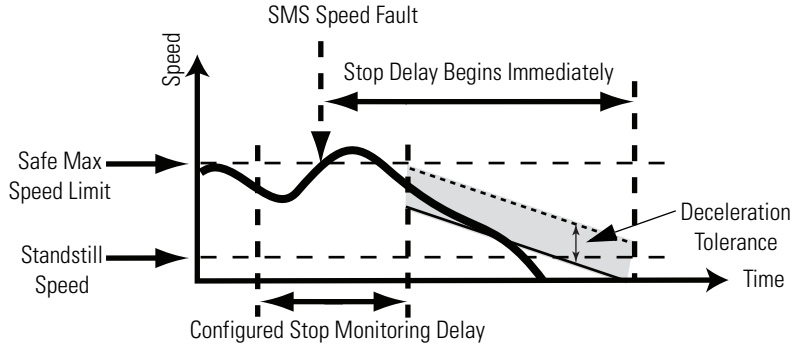
You define the Safe Stop Type initiated by the relay in the event of an SMS Speed Fault by using the P63 [Max Spd Stop Typ] parameter.

Safe Maximum Speed Monitoring Stop Behavior

P63 [Max Spd Stop Typ] Parameter	Description
0 = Use Safe Torque Off with Check for Standstill (Torque Off)	The speed monitoring relay initiates Safe Torque Off with Check for Standstill any time an SMS Speed Fault is detected while the relay is monitoring motion.
1 = Use Configured Stop Type (Safe Stp Typ)	The speed monitoring relay initiates the configured Safe Stop Type (parameter 45) any time an SMS Speed Fault is detected while the relay is monitoring motion.

If an SMS Speed Fault is detected during a Stop Monitoring Delay, [Stop Mon Delay], the delay ends immediately and the configured Stop Delay [Max Stop Time] begins.

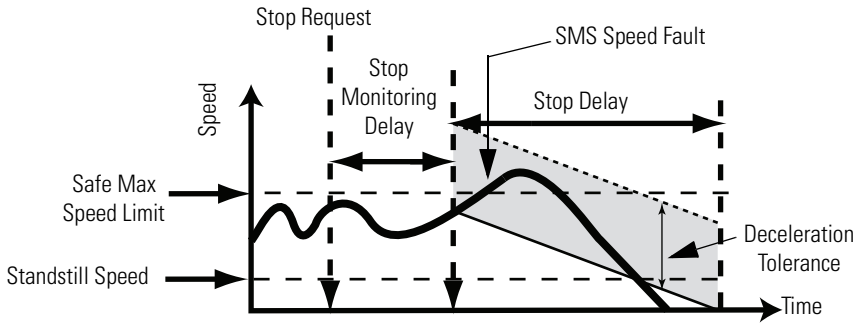
SMS Speed Fault During Stop Monitoring Delay



If an SMS Speed Fault is detected during the Stop Delay [Max Stop Time], and the P63 [Max Spd Stop Typ] parameter equals Use Configured Stop Type (Safe Stp Typ), and the feedback signals indicate less than the maximum frequency(1) for your encoder type, the fault is reported, but no further action is taken. Deceleration monitoring performs the safety function during the Stop Delay [Max Stop Time]. That is, if an SMS Speed Fault occurs during the Stop Delay [Max Stop Time], the fault is ignored and the stopping action continues.

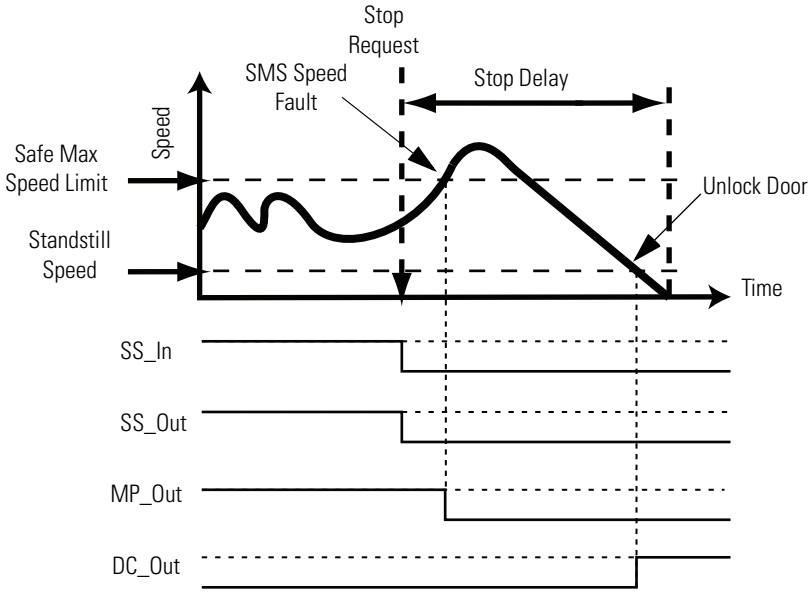
(1) 100 kHz for Sin/Cos or 200 kHz for Incremental

SMS Speed Fault When P63 [Max Spd Stop Typ] Set to 'Use Configured Stop Type (Safe Stp Typ)'



If an SMS Speed Fault is detected during the Stop Delay [Max Stop Time] and the P63 [Max Spd Stop Typ] parameter equals Use Safe Torque Off with Check for Standstill (Torque Off), the SMS Speed Fault is reported and the MP_Out output is set to OFF. The Stop Delay [Max Stop Time] continues with standstill checking enabled.

SMS Speed Fault When P63 [Max Spd Stop Typ] Set to 'Use Safe Torque Off with Check for Standstill (Torque OFF)'



For more information about faults, see Fault Reactions on page 190.

Safe Maximum Acceleration (SMA) Monitoring

Configure Safe Maximum Acceleration monitoring by setting the P64 [Max Accel Enable] parameter to Enable. When configured, Safe Maximum Acceleration Monitoring is active any time the relay configuration is valid and Safety Mode is not set to Disabled.

The resolution accuracy of the acceleration monitoring in revolutions/second^2 is equal to the speed resolution in

$$\frac{\text{(RPM x 2)} \div 60}{\text{[(OverSpd Response - 36)/1000] seconds}}$$

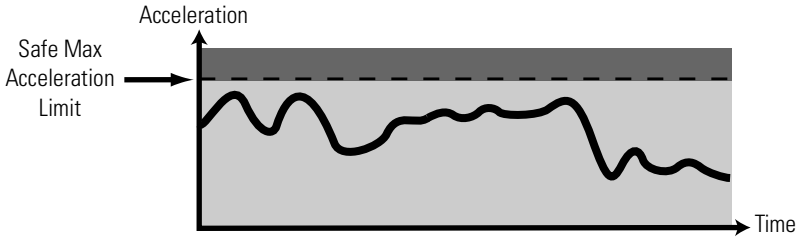
The resolution accuracy of the acceleration monitoring in mm/second^2 is equal to the speed resolution in

$$\frac{\text{(mm/s x 2)}}{\text{[(OverSpd Response - 36)/1000] seconds}}$$

IMPORTANT Acceleration is measured within the Overspeed Response Time, P24 [OvrSpd Response].

When you configure the relay for Safe Maximum Acceleration, the relay monitors the acceleration rate and compares it to a configured Safe Maximum Acceleration Limit, P65 [Safe Accel Limit]. If the acceleration is greater than or equal to the configured Safe Maximum Acceleration Limit, an Acceleration Fault (Stop Category Fault) occurs.

Safe Max Acceleration Timing Diagram



You define the Safe Stop Type initiated by the relay in the event of an Acceleration Fault by using the P66 [Max Acc Stop Typ] parameter.

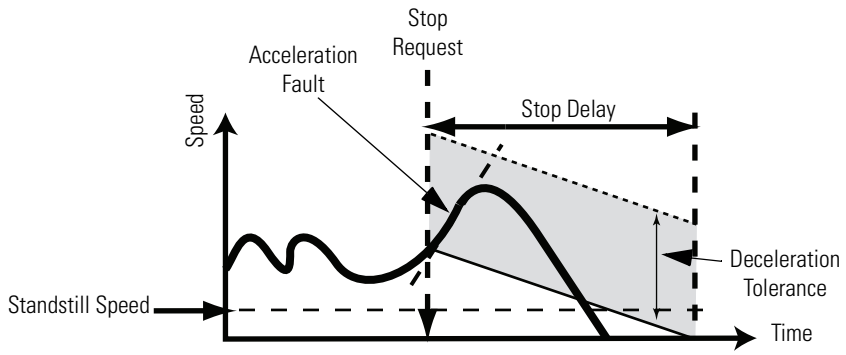
Safe Maximum Acceleration Monitoring Stop Behavior

P66 [Max Acc Stop Typ] Parameter	Description
0 = Use Safe Torque Off with Check for Standstill (Torque Off)	The speed monitoring relay initiates Safe Torque Off with Check for Standstill any time an Acceleration Fault is detected while the relay is monitoring motion.
1 = Use Configured Stop Type (Safe Stp Typ)	The speed monitoring relay initiates the configured Safe Stop Type any time an Acceleration Fault is detected while the relay is monitoring motion.

If an Acceleration Fault is detected during a Stop Monitoring Delay [Stop Mon Delay] and the P66 [Max Acc Stop Typ] parameter is configured as Use Safe Torque Off with Check for Standstill (Torque Off), the Stop Monitoring Delay [Stop Mon Delay] ends immediately and Stop Delay [Max Stop Time] begins.

If an Acceleration Fault is detected during the Stop Delay [Max Stop Time], and the P66 [Max Acc Stop Typ] parameter equals Use Configured Stop Type (Safe Stp Typ), and feedback signals indicate less than the maximum frequency(1) for your encoder type, then the fault occurs with no further action. Deceleration Monitoring performs the safety function during the Stop Delay [Max Stop Time]. That is, if an Acceleration Fault occurs during the Stop Delay [Max Stop Time], the fault is ignored and the stopping action continues.

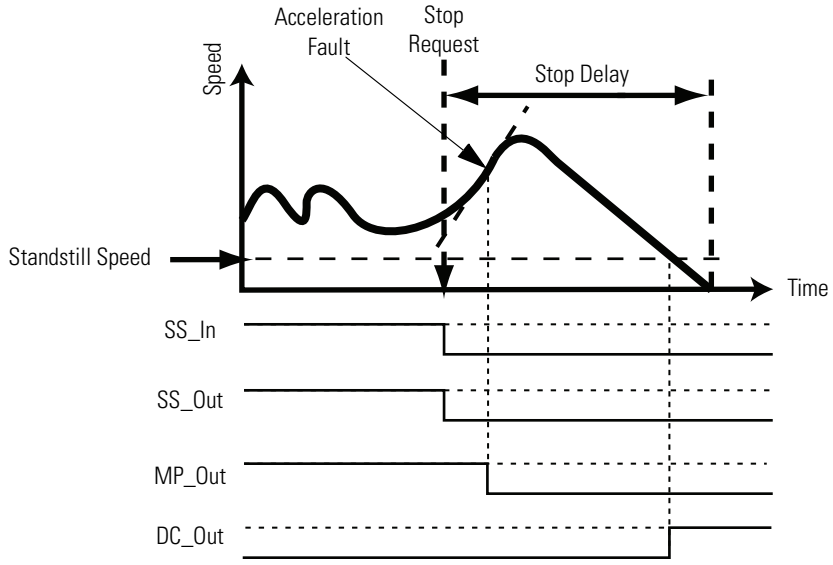
Acceleration Fault When P66 [Max Acc Stop Typ] Set to 'Use Configured Stop Type (Safe Stp Typ)'



If an Acceleration Fault is detected during the Stop Delay [Max Stop Time] and the P66 [Max Acc Stop Typ] parameter equals Use Safe Torque Off with Check for Standstill (Torque Off), the Acceleration Fault is reported and the MP_Out output is set to OFF. The Stop Delay [Max Stop Time] continues with standstill checking enabled.

(1) 100 kHz for Sin/Cos or 200 kHz for Incremental

Acceleration Fault When P66 [Max Acc Stop Typ] Set to 'Use Safe Torque Off with Check for Standstill (Torque OFF)'.



For more information about faults, see Fault Reactions on page 190.

Safe Direction Monitoring (SDM)

When configured for Safe Direction Monitoring, the relay monitors the feedback direction and initiates the configured Safe Stop Type when motion in the illegal direction is detected. You configure Safe Direction Monitoring using the P42 [Direction Mon] parameter. This parameter also determines the direction, positive or negative, in which motion is allowed.

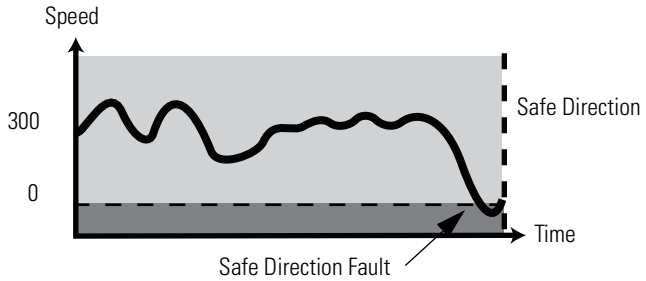
Enable Safe Direction Monitoring

P42 [Direction Mon] Parameter	Description
0 = Disabled	Safe Direction Monitoring is disabled.
1 = Positive Always	Safe Direction Monitoring is active any time the configuration is valid and not Disabled.
2 = Negative Always	
3 = Positive During SLS	Safe Direction Monitoring is performed only when the relay is actively monitoring Safe Limited Speed.
4 = Negative During SLS	

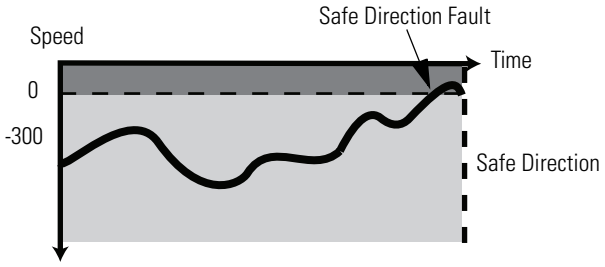
IMPORTANT Be sure to set the P30 [Fbk 1 Polarity] and P35 [Fbk 2 Polarity] configuration parameters properly for a consistent direction between encoder 1 and encoder 2.

You may configure a position limit, in encoder units, tolerated in the wrong direction before a Direction Fault occurs, by using the P43 [Direction Tolerance] parameter.

Positive Safe Direction Monitoring Diagram



Negative Safe Direction Monitoring Diagram



If motion is detected in the incorrect direction while Safe Direction Monitoring is active, a Direction Fault occurs. If a Direction Fault is detected while the relay is monitoring motion, the configured Safe Stop Type is initiated and direction monitoring is not performed during the safe stop. If a Direction Fault is first detected after the initiation of the safe stop, then all outputs go to their faulted state.

For more information about faults, see Fault Reactions on page 190.

Max Speed, Max Accel, and Direction Monitoring Parameter List

Set these parameters to configure Safe Maximum Speed, Safe Maximum Acceleration, and Safe Direction Monitoring.

Parameter		Description	Setting
30	Fbk 1 Polarity	Defines the direction polarity for encoder 1.	Default: 0 = Same as encoder (Normal)
			Options: 0 = Same as encoder (Normal) 1 = Reversed
35	Fbk 2 Polarity	Defines the direction polarity for encoder 2.	Default: 0 = Same as encoder (Normal)
			Options: 0 = Same as encoder (Normal) 1 = Reversed

Parameter		Description	Setting
42	Direction Mon	Defines the allowable direction if Safe Direction Monitoring is enabled.	Default: 0 = Disabled Options: 0 = Disabled 1 = Positive always (Pos Always) 2 = Negative always (Neg Always) 3 = Positive during safe limited speed monitoring (Pos in SLS) 4 = Negative during safe limited speed monitoring (Neg in SLS)
43	Direction Tol	The position limit in encoder units tolerated in the wrong direction when Safe Direction Monitoring is active.	Default: 10 Range: 0...65,535 deg or mm based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
61	Max Speed Enable	Enable Safe Maximum Speed Monitoring.	Default: 0 = Disabled Options: 0 = Disabled 1 = Enabled
62	Safe Max Speed	Defines the maximum speed limit that will be tolerated if Safe Maximum Speed monitoring is enabled.	Default: 0 Range: 0...65,535 rpm or mm/s based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
63	Max Spd Stop Typ	Safe Maximum Speed Monitoring Stop Behavior. Defines the stopping behavior that will be initiated in the event of an SMS Speed Fault. See Safe Maximum Speed (SMS) Monitoring on page 145.	Default: 0 = Use Safe Torque Off with Standstill Checking (Torque Off) Options: 0 = Use Safe Torque Off with Standstill Checking (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)
64	Max Accel Enable	Enable Safe Maximum Acceleration Monitoring.	Default: 0 = Disabled Options: 0 = Disabled 1 = Enabled
65	Safe Accel Limit	Defines the Safe Maximum Acceleration Limit, relative to encoder 1, for which the system is being monitored.	Default: 0 Range: 0...65,535 rev/s^2 or mm/s^2 based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter
66	Max Acc Stop Typ	Safe Max Acceleration Monitoring Stop Behavior. Defines the stopping behavior that will be initiated in the event of an Acceleration Fault. See Safe Maximum Acceleration (SMA) Monitoring on page 148.	Default: 0 = Use Safe Torque Off with Check for Standstill (Torque Off) Range: 0 = Use Safe Torque Off with Check for Standstill (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)

Safety Configuration and Verification

Introduction

Topic	Page
Safety Configuration	153
Basics of Application Development and Testing	156
Commissioning the System	156
Editing the Configuration	160

Safety Configuration

When you configure a speed monitoring safety system, you must record and verify the configuration signature, and set the safety-lock status of the system configuration. An optional password can be configured to help protect the system configuration from unauthorized modifications.

Configuration Signature ID

The configuration Signature ID is an identification number that uniquely identifies a specific configuration for a safety device. Each time the system is configured or reconfigured, a new configuration signature is generated to identify that specific configuration.

You can view the configuration Signature ID by accessing the P10 [Signature ID] parameter.

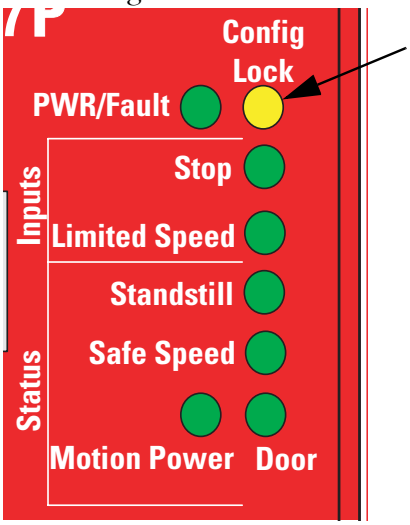
Safety-lock

When you have verified the operation of the system and recorded the configuration Signature ID, you must lock the configuration to protect it from modification.

IMPORTANT If you do not safety-lock the configuration, untested or unintentional changes can be made to the device configuration, which could result in unexpected system behavior.

You lock the configuration by using the P5 [Lock State] parameter.

The Config Lock status indicator on the relay illuminates solid yellow when the configuration is locked. The Config Lock status indicator flashes yellow when the configuration is unlocked.



You can also check the safety-lock status of the system by viewing the Configuration Lock bit (bit 1) in the P68 [Guard Status] parameter. If the bit equals 1, the configuration is locked. If it equals 0, the configuration is unlocked.

Set a Password

You can protect the system configuration by using an optional password. If you set a password, edits to the configuration, as well as safety-locking and relay reset operations require the password to be entered. You can set a password when the relay is not safety-locked and the P6 [Operating Mode] parameter value equals 0 (Program).

Follow these steps to set a new password.

1. If you previously configured a password, enter the password by using the P1 [Password] parameter.
2. Enter the new password by using the P13 [New Password] parameter.
3. Set the P17 [Password Command] parameter to 1, which equals Change Password.

Parameter		Description	Setting
1	Password	Password for Lock and Unlock function.	Range: 0...4,294,967,295
13	New Password	32-bit configuration password	Range: 0…4,294,967,295
17	Password Command	Save new password command.	Default: 0 = No action
			Options: 0 = No action 1 = Change Password 2 = Reset Password

Reset the Password

If you forget the password and need to reset it, follow these steps.

1. Read the contents of the P18 [Security Code] parameter.
2. Contact Rockwell Automation Technical Support (440-646-5800) and provide the Security Code value and the serial number of the relay.

   A technical support representative will use the security code to calculate a Vendor Password value.
3. Enter the value provided by your Rockwell Automation Technical Support representative into the P19 [Vendor Password] parameter.
4. Set the P17 [Password Command] parameter to 2, which equals Reset Password.
5. Enter the new password using the P13 [New Password] parameter.
6. Set the P17 [Password Command] parameter to 1, which equals Change Password.

Reset the Relay

When the relay is unlocked and the P6 [Operating Mode] parameter equals 0 (Program), you can reset the relay's configuration parameters to their factory default settings, by setting the P7 [Reset Defaults] parameter to 1. The reset parameters are sent to the relay when the P6 [Operating Mode] parameter is changed to 1 (Run).

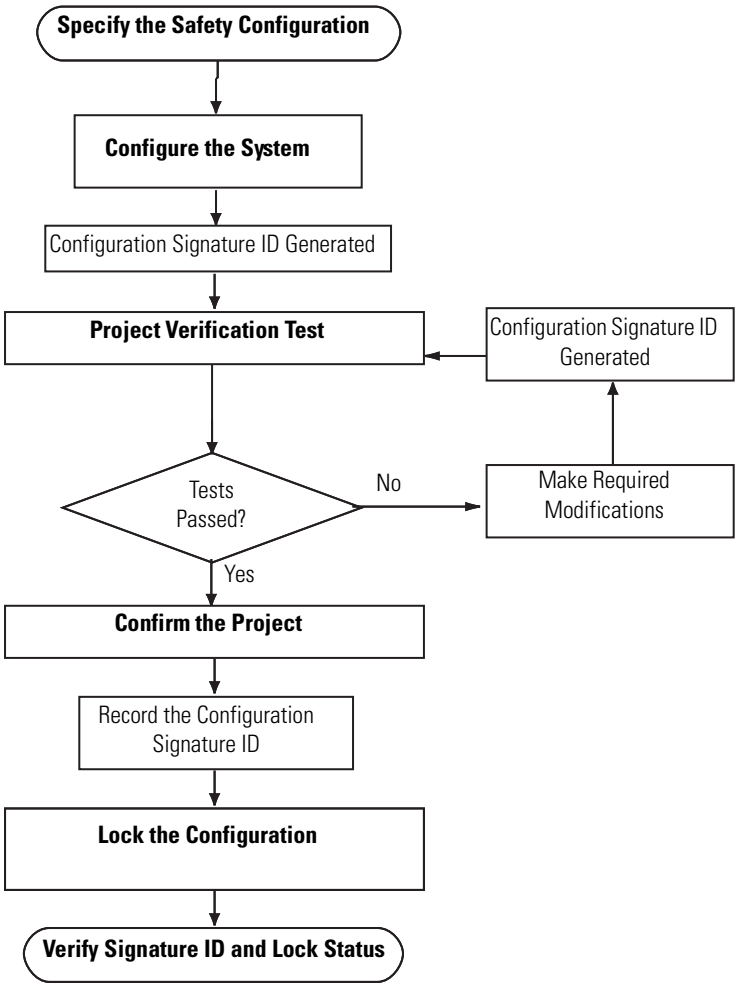
Basics of Application Development and Testing

Configuration for the intended SIL CL3, PL(e), or Cat 4 system should be carried out by the system integrator or a user trained and experienced in safety applications. The developer must follow good design practices.

- Use functional specifications, including flow charts, timing diagrams and sequence charts.
- Perform a configuration review.
- Perform configuration validation.

Commissioning the System

The flowchart shows the steps required for commissioning a Speed Monitoring safety system. The items in bold are explained in the following sections.



Specify the Safety Configuration

You must create a specification for the system configuration that addresses the safety requirements identified by a risk assessment of your application. Use the specification to verify that the configuration is selected correctly and that it fully addresses your application's functional and safety control requirements. The specification must be a detailed description that may include (if applicable):

- a sequence of operations.
- flow and timing diagrams.
- sequence charts.
- a configuration description of each parameter.
- documented descriptions of the steps with step conditions and actuators to be controlled.
- input and output definitions.
- I/O wiring diagrams and references.
- a theory of operation.
- a matrix or table of stepped conditions and the actuators to be controlled, including sequence and timing diagrams.
- a definition of marginal conditions, for example, operating modes.

The I/O portion of the specification must contain the analysis of field circuits, that is, the type of sensors and actuators.

- Sensors (Digital or Analog)
  - Signal in standard operation (dormant current principle for digital sensors, sensors OFF means no signal)
  - Determination of redundancies required for SIL levels
  - Discrepancy monitoring and visualization, including your diagnostic logic
- Actuators
  - Position and activation in standard operation (normally OFF)
  - Safe reaction/positioning when switching OFF or power failure.
  - Discrepancy monitoring and visualization, including your diagnostic logic.

Configure the Speed Monitoring Relay

You configure the relay using a HIM (catalog number 20-HIM-A3) to set the configuration parameters. You can also use DriveExplorer software, version 5.02 or later, or DriveExecutive software, version 4.01 or later.

The relay is configured in the Safe State. The relay must be unlocked to be configured. If a password exists, you must provide the password to unlock the relay.

Follow these steps to configure the relay.

1. Unlock the relay configuration, if it is locked, by setting the P5 [Lock State] parameter to 0 (Unlock).
2. If an error occurs, you need to enter the password, by using the P1 [Password] parameter.
3. Place the relay in Program mode by setting the P6 [Operating Mode] parameter to 0.

   If you are using DriveExplorer or DriveExecutive software, you will see the P10 [Signature ID] parameter value change to 0.

   IMPORTANT When the relay is in Program mode, the P69 [IO Diag Status] parameter is not updated or refreshed.

4. Edit parameters to meet your system configuration specification and risk assessment requirements.
5. When you are finished editing parameters, set the P6 [Operating Mode] parameter to 1, which puts the relay into Run mode.

   A configuration Signature ID is generated.
6. Record the configuration Signature ID from the contents of the P10 [Signature ID] parameter.
7. Enter the password, if required.
8. Set the P5 [Lock State] parameter to 1 (Lock).

For a complete list of parameters and settings for the MSR57P relay, see Appendix B.

Project Verification Test

To check that the speed monitoring relay's configuration adheres to the application specification, you must generate a suitable set of test cases covering the application. The set of test cases must be filed and retained as the test specification. You must include a set of tests to prove the validity of the safety configuration parameters.

You must perform a complete functional test of the entire system before the operational startup of a safety-related system.

Confirm the Project

You must check each parameter to make sure it is set to the correct value according to your system configuration specification.

Safety Validation

An independent, third-party review of the safety system may be required before the system is approved for operation. An independent, third-party certification is required for IEC 61508 SIL CL3.

Verify the Signature and Lock at the Speed Monitoring Relay

To meet SIL CL3, PL(e), Cat 4 requirements, you must verify that the correct configuration is locked in the speed monitoring relay.

To verify the configuration Signature ID, view the contents of the P10 [Signature ID] parameter and make sure that it matches the configuration Signature ID you recorded as part of the configuration process on page 158.

To verify the lock status, you can view the Config Lock status indicator on the speed monitoring relay. The Config Lock indicator is solid yellow when the configuration is locked and flashing yellow when it is unlocked.

To verify the lock status, you can view the status of the P5 [Lock State] parameter as well as the status of the Configuration Lock bit (bit 1) of the P68 [Guard Status] parameter. If the bit equals 1, the configuration is locked. If the bit equals 0, the configuration is unlocked.

Editing the Configuration

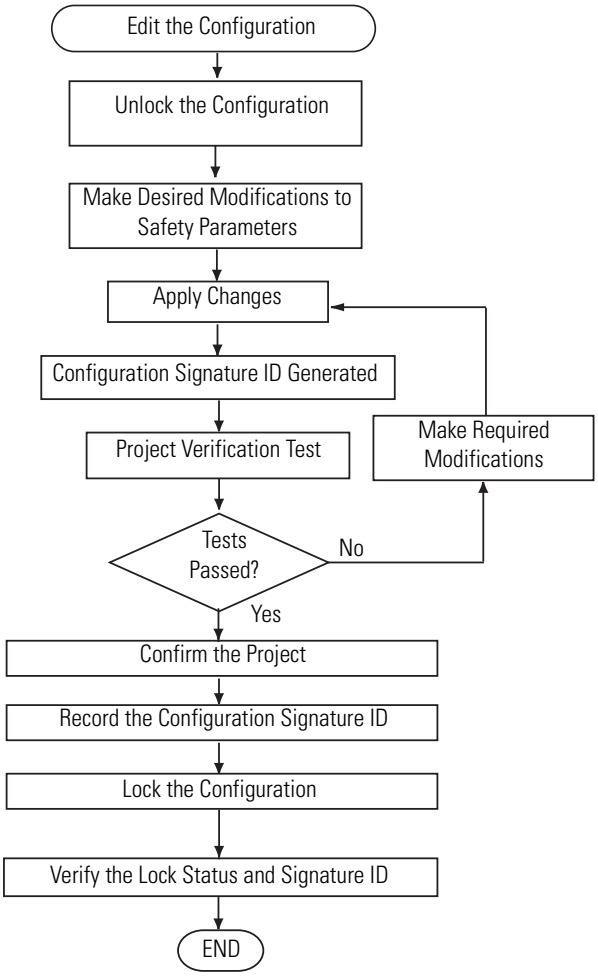
Only authorized, specially-trained personnel can make edits to the configuration. These personnel should use all supervisory methods available, for example, using the software password protections.

When authorized, specially-trained personnel make edits, they assume the central safety responsibility while the changes are in progress. These personnel must also maintain safe application operation.

You must sufficiently document all edits, including:

- authorization.
- impact analysis.
- execution.
- test information.
- revision information.

The flowchart shows the steps necessary to edit the speed monitoring relay's configuration.



Configuration Examples

Introduction

These examples guide you through the basic steps required to program an application that uses some of the safety functions of the MSR57P Relay. The remaining chapters of this manual provide detailed information on the operation of each safety function.

Topic	Page
Example Application 1	161
Example Application 2	172

Example Application 1

This example application uses the following basic configuration in a single-axis system.

- Safe Stop (SS) enabled with an E-stop button.
- Safe Limited Speed (SLS) initiated with a 2NC contact switch.
- Door Monitoring (DM) of a guardlocking switch (TLS-3 GD2) configured as Power to Release.
- A Reset button with 1 NO contact.
- One encoder connected with Sin/Cos output signal and resolution of 1024.
- A configured Safe Maximum Speed (SMS) limit.

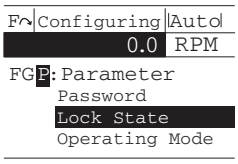
Each of the following sections describes the settings you need to enter for each parameter group. You can use a HIM, or DriveExplorer or DriveExecutive software to configure the relay.

For information on connecting and using a HIM, see Appendix C. For information on connecting to a personal computer and using software for configuration, see Appendix D.

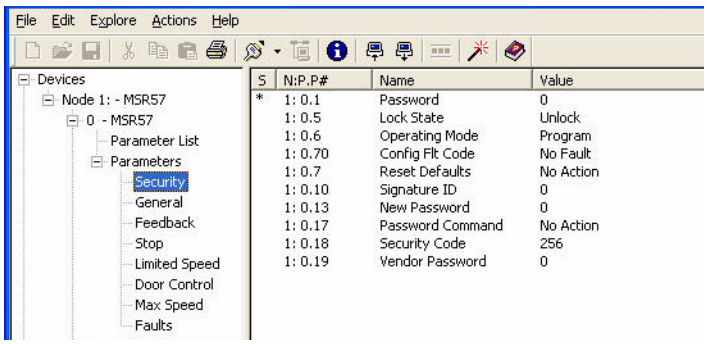
Example 1: Initial Security Group Settings

Security Group Parameters

HIM Screen



Software Screen



Follow these steps to put the relay into Program mode for configuration.

1. From the Security group, choose the P5 [Lock State] parameter.

   The default value of the Lock State parameter is 0 or unlocked. The locked or unlocked state is also indicated by the Config Lock status indicator on the front of the relay. Flashing yellow is unlocked; solid yellow is locked.

2. If the relay is locked (Lock State parameter value equals 1), set the P5 [Lock State] parameter value to 0.

   If an error occurs, a password has been configured to protect the relay configuration.

3. Choose the P1 [Password] parameter.

4. Type the password.

5. Choose the P6 [Operating Mode] parameter.

   The default value is 0, which equals Program.

6. If the relay is in Run mode (Operating Mode parameter equals 1), set the Operating Mode parameter to 0 to enable you to enter a new configuration.

7. If you want to configure a password or change the password, choose the P13 [New Password] parameter.

   The default value is 0. Enter a value from 0…4,294,967,295.

8. Type the new password value.

9. Choose the P17 [Password Command] parameter.

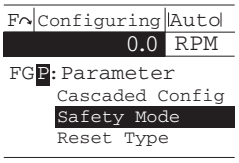
10. Set the Password Command parameter value to 1, which equals Change Password (Change PW).

11. Go to the next section to set the parameters found in the General parameters group.

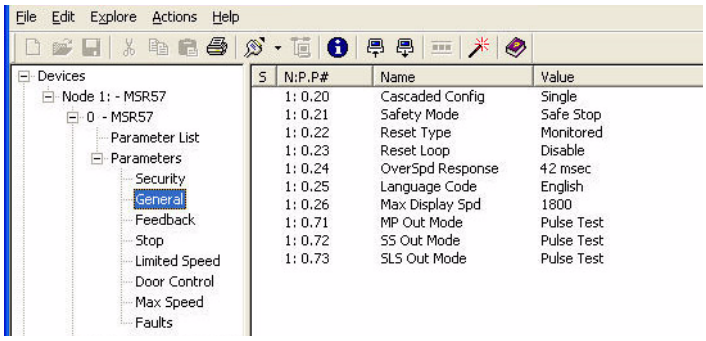
Example 1: General Group Settings

General Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the general operation of the relay.

1. From the General group, choose the P20 [Cascaded Config] parameter.

2. Set the Cascaded Config parameter to 0 (default) to configure the relay as a Single unit.

3. Choose the P21 [Safety Mode] parameter.

   The default setting is 1, which equals Safe Stop.

4. Set the Safety Mode parameter value to 4 for Master, Safe Limited Speed with Door Monitoring mode (Lim Speed DM).

   In this mode, the door is locked when the machine speed is above a configured Safe Speed Limit. The door can be unlocked when the machine is at Standstill Speed or is at or below the Safe Speed Limit and the SLS_In input is OFF.

5. Choose the P22 [Reset Type] parameter.

6. Set the Reset Type parameter value to 2 (default), which equals Manual Monitored (Monitored).

   The Manual Monitored setting requires a closing and opening of the reset circuit for a reset.

7. Choose the P23 [Reset Loop] parameter.

8. Set the Reset Loop parameter value to 0 (default) to disable reset qualification monitoring.

   This setting assumes that there are no external contactors or devices connected to the system which require monitoring.

9. Choose the P24 [OverSpd Response] parameter.

   The default Overspeed Response time is 42 ms.

10. Set the OverSpd Response parameter value to 1, which equals 48 ms.

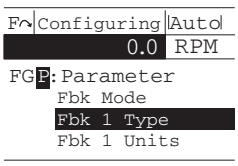
    See Overspeed Response Time on page 75 for details.

11. Go to the next section to configure the type of feedback using the Feedback parameters group.

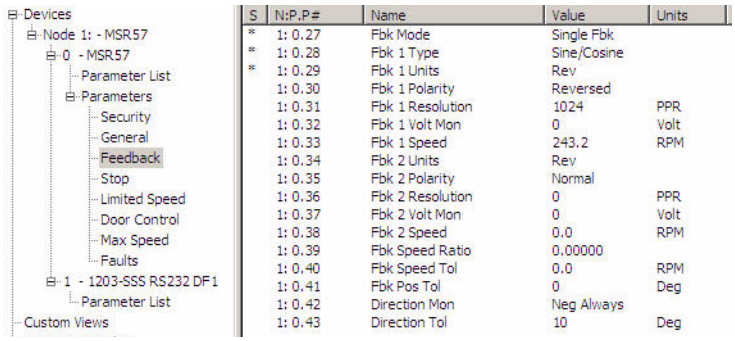
Example 1: Feedback Group Settings

Feedback Group Parameters

HIM Screen



Software Screen


Devices
Node 1: - MSR57
0 - MSR57
Parameter List
Parameters
Security
General
Feedback
Stop
Limited Speed
Door Control
Max Speed
Faults
1 - 1203-SSS RS232 DF1
Parameter List
Custom Views
S N:P.P# Name Value Units
* 1: 0.27 Fbk Mode Single Fbk
* 1: 0.28 Fbk 1 Type Sine/Cosine
* 1: 0.29 Fbk 1 Units Rev
1: 0.30 Fbk 1 Polarity Reversed
1: 0.31 Fbk 1 Resolution 1024 PPR
1: 0.32 Fbk 1 Volt Mon 0 Volt
1: 0.33 Fbk 1 Speed 243.2 RPM
1: 0.34 Fbk 2 Units Rev
1: 0.35 Fbk 2 Polarity Normal
1: 0.36 Fbk 2 Resolution 0 PPR
1: 0.37 Fbk 2 Volt Mon 0 Volt
1: 0.38 Fbk 2 Speed 0.0 RPM
1: 0.39 Fbk Speed Ratio 0.00000
1: 0.40 Fbk Speed Tol 0.0 RPM
1: 0.41 Fbk Pos Tol 0 Deg
1: 0.42 Direction Mon Neg Always
1: 0.43 Direction Tol 10 Deg

Follow these steps to configure the type of feedback used by the relay.

1. From the Feedback group, choose the P27 [Fbk Mode] parameter.

2. Set the Fbk Mode parameter value to 0 (default) for redundant processing and cross-checking of the single encoder input in a 1oo2 architecture.

3. Choose the P28 [Fbk 1 Type] parameter.

   The default value is 1 for incremental encoder input.

4. Set the Fbk 1 Type parameter value to 0 for Sine/Cosine and internal monitoring of the single encoder input.

5. Choose the P29 [Fbk 1 Units] parameter.

6. Set the Fbk 1 Units parameter to 0 (default), which equals Rotary feedback.

7. Choose the P30 [Fbk 1 Polarity] parameter.

8. Set the Fbk 1 Polarity parameter to 0 (default) to set up the direction for monitoring to be the same as the encoder direction (Normal).

9. Choose the P31 [Fbk 1 Resolution] parameter.

10. Choose 1024 (default) or enter value between 1…65,535 pulses/revolution based on the encoder's specifications.

11. Choose the P32 [Fbk 1 Volt Mon] parameter.

12. Enter 5, 9, 12, or 14V to monitor voltage in accordance with the encoder's specifications, or enter 0 (default) to disable encoder voltage monitoring

TIP The P33 [Fbk 1 Speed] parameter displays the output speed of the encoder as a value between -214,748,364.8…214,748,364.8 rpm based on the encoder's configuration. You do not need to enter a setting or value for this parameter.

13. Choose the P42 [Direction Mon] parameter.

14. Set the Direction Mon parameter value to 0 (default), which equals Disabled.

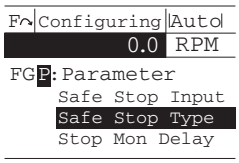
    You may disable Safe Direction Monitoring if only one direction of rotation is possible or there is no safety-related restriction on the direction of rotation.

15. Go to the next section to set the parameters found in the Stop parameters group.

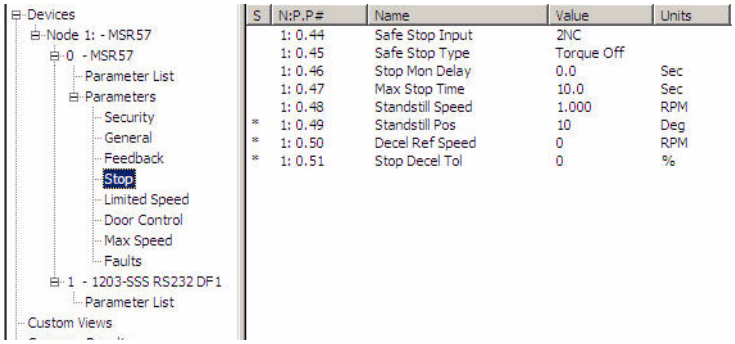
Example 1: Stop Group Settings

Stop Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the Stop operation of the relay.

1. From the Stop group, choose the P44 [Safe Stop Input] parameter.

2. Set the Safe Stop Input parameter value to 1 (default) for 2NC (dual-channel equivalent) operation.

   In this example application, the Safe Stop input (SS_In) monitors an E-Stop button with two normally-closed (2NC) contacts.

3. Choose the P45 [Safe Stop Type] parameter.

4. Set the Safe Stop Type parameter value to 0 (default), which equals Safe Torque Off with Standstill Speed Checking (Torque Off).

   Safe Torque Off with Standstill Speed Checking (Torque Off) switches off motion power immediately after an E-Stop command and sets door control to Unlock when the Standstill Speed is detected.

5. Choose the P47 [Max Stop Time] parameter.

   The default value is 10 s, but you can enter a value from 0…6553.5 s.

6. Type the value of the expected coast-to-stop time plus a reasonable tolerance after the Safe Stop command is initiated.

   If the machine's speed is not below the Standstill Speed within the Stop Delay [Max Stop Time] you entered, a Stop Speed Fault occurs and door control remains set to Lock until the Standstill Speed is reached.

7. Choose the P48 [Standstill Speed] parameter.

   The default value is 0.001 rpm, but you can enter a value from 0.001…65,535 rpm. The Standstill Speed is measured in revolutions per minute, because the P29 [Fbk 1 Units] parameter is configured for Rotary feedback.

8. Enter a value in the Standstill Speed parameter field to define the speed at which the relay determines standstill has been reached.

9. Choose the P49 [Standstill Pos] parameter.

   The default value is 10 degrees, but you can enter a value from 0…65,535 degrees. The Standstill Position is measured in degrees because the P29 [Fbk 1 Units] parameter is configured for Rotary feedback.

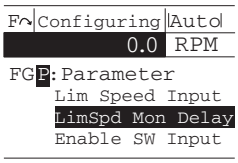
10. Enter the value to define the position limit in encoder units that is tolerated after standstill has been reached.

11. Go to the next section to set the parameters found in the Limited Speed parameters group.

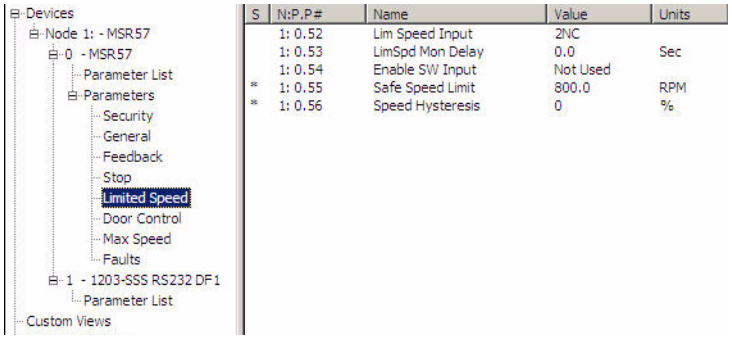
Example 1: Limited Speed Group Settings

Limited Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the Safe Limited Speed operation.

1. From the Limited Speed group, choose the P52 [Lim Speed Input] parameter.

   The default value is 0 (Disabled), for applications without Safe Limited Speed control.

2. Set the Lim Speed Input parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the Safe Limited Speed input (SLS_In) monitors a switch with two normally-closed (2NC) contacts. If the NC contacts are open and speed exceeds the configured Safe Limited Speed, the relay initiates the configured Safe Stop Type.

   When the relay is actively monitoring Safe Limited Speed and the machine's speed is at or below the configured Safe Speed Limit, the gate interlock is released and the door can be opened.

3. Choose the P55 [Safe Speed Limit] parameter.

   The default value is 0 rpm or mm/s. The valid range is from 0…6553.5.

4. Type the maximum allowable rpm value for safe (reduced) velocity.

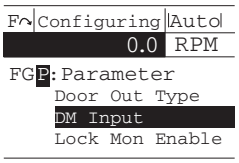
   The speed is calculated in rpm, based on the Fbk 1 Units parameter setting (0 = Rotary feedback) entered previously.

5. Go to the next section to set the parameters that configure Door Control operation.

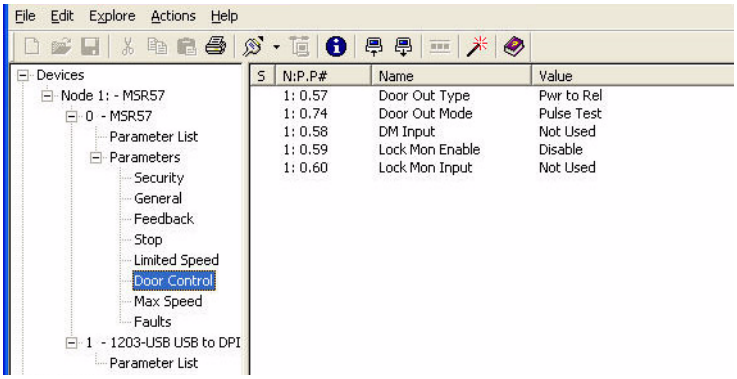
Example 1: Door Control Group Settings

Door Control Group Parameters

HIM Screen



Software Screen



Follow these steps to configure Door Control operation for the relay.

1. From the Door Control group, choose the P57 [Door Out Type] parameter.

2. Set the Door Out Type parameter to 0 (default), which equals Power to Release (Pwr to Rel).

   This setting was chosen because power must be applied to the solenoid inside the TLS-3 GD2 gate switch to release the gate interlock.

3. Choose the P58 [DM Input] parameter.

   The default setting is 0 for applications that do not use an interlock switch.

4. Set the DM Input parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the DM Input (DM_In) monitors the TLS-3 GD2 switch, which has two normally-closed (2NC) safety contacts.

5. Choose the P59 [Lock Mon Enable] parameter.

   The default value is 0 (Disabled) for applications without an interlock switch.

6. Set the Lock Mon Enable parameter value to 1 (Enabled) because this application uses the TLS-3 GD2 interlock switch.

7. Choose the P60 [Lock Mon Input] parameter.

   The default value is 0 (Not Used) for applications that do not use an interlock switch.

8. Set the Lock Mon Input parameter value to 1 for 2NC (dual-channel equivalent) operation.

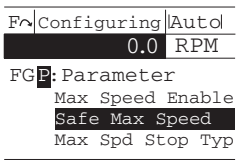
   In this example application, the Lock Monitor Input (LM_In) monitors the TLS-3 GD2 switch, which has two normally-closed (2NC) interlock monitoring contacts.

9. Go to the next section to set the parameters that configure Safe Maximum Speed monitoring.

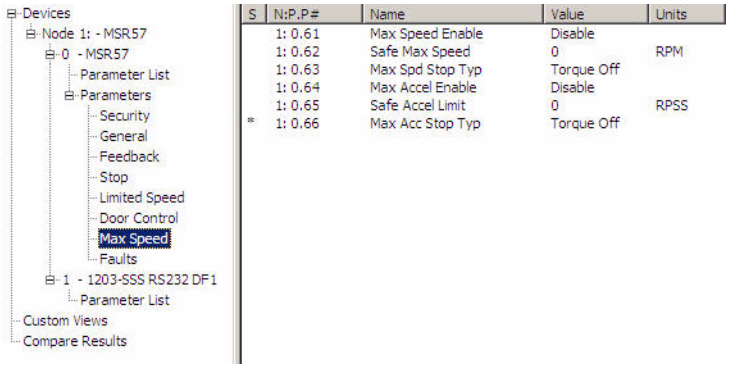
Example 1: Max Speed Group

Max Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure Maximum Speed monitoring for the relay.

1. From the Max Speed group, choose the P61 [Max Speed Enable] parameter.

   The default value is 0 (Disabled) for no maximum speed limitation.

2. Set the Max Speed Enable parameter value to 1 (Enabled), which monitors that the encoder feedback signal does not exceed the velocity configured using the Safe Max Speed parameter.

3. Choose the P62 [Safe Max Speed] parameter.

   The default value is 0 rpm or mm/s. Enter a value from 0…6553.5.

4. Type the maximum allowable rpm value for velocity.

   The speed is calculated in rpm, based on the Fbk 1 Units parameter setting (0 = Rotary feedback) entered previously.

5. Choose the P63 [Max Spd Stop Typ] parameter.

6. Set the Max Spd Stop Typ parameter value to 0 (default), which equals Use Safe Torque Off with Standstill Checking (Torque Off).

   With this configuration, if speed exceeds the configured Safe Max Speed, the relay initiates a Safe Torque Off with Standstill Checking type of Safe Stop, regardless of the configured Safe Stop Type.

7. Go on to the next section to put the relay into Run mode and lock the configuration.

Example 1: Final Security Group Settings

This example only includes the steps for entering a configuration using the HIM module or software program. You must also follow the requirements described in Chapter 10, Safety Configuration and Verification.

ATTENTION

You must verify the configuration and validate the entire system, including a complete functional test, before the operational startup of any safety-related system.

Only authorized, specially-trained personnel, experienced in the commissioning and operation of safety-related systems may configure, test, and confirm the project.

Follow these steps to put the relay into Run mode, generate a configuration signature, and lock the configuration.

1. From the Security group, choose the P6 [Operating Mode] parameter.

2. Set the Operating Mode parameter value to 1, which equals Run mode.

   A configuration signature is generated.

3. Choose the P10 [Signature ID] parameter and record the configuration signature value stored in this parameter.

4. If you configured a password, choose the P1 [Password] parameter and type the password.

5. Choose the P5 [Lock State] parameter.

6. Set the Lock State parameter value to 1 (Lock) to lock the configuration.

The Config Lock status indicator is solid yellow when the relay configuration is locked.

Example Application 2

This example application shows how to change the default configuration settings to set up the MSR57P relay for an application with these basic parameters:

- Safe Stop (SS) enabled with an E-stop button.
- Safe Limited Speed (SLS) initiated with a 2NC contact switch.
- A configured Safe Maximum Speed (SMS) limit.
- Door Monitoring (DM)
- Door Control (DC) to control a guardlocking switch (TLS-3 GD2, Power to Release style).
- A Reset button with 1NO contact.
- Enabling Switch (ESM) with 2NC contacts. Hold the switch in the middle position to access the machine for maintenance while it is running at Safe Limited Speed.
- One encoder connected with Sin/Cos output signal and resolution of 1024.

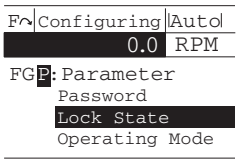
Each of the following sections describes the settings you need to enter for each parameter group. You can use a HIM, or DriveExplorer or DriveExecutive software to configure the relay.

For information on connecting and using a HIM, see Appendix C. For information on connecting to a personal computer and using software for configuration, see Appendix D.

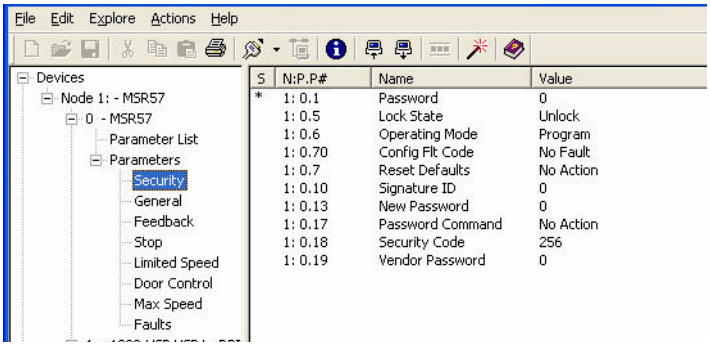
Example 2: Initial Security Group Settings

Security Group Parameters

HIM Screen



Software Screen



Follow these steps to put the relay into Program mode for configuration.

1. From the Security group, choose the P5 [Lock State] parameter.

   The default value of the Lock State parameter is 0 or unlocked. The locked or unlocked state is also indicated by the Config Lock status indicator on the front of the relay. Flashing yellow is unlocked; solid yellow is locked.

2. If the relay is locked (Lock State parameter value equals 1), set the Lock State parameter value to 0.

   If an error occurs, a password has been configured to protect the relay configuration.

3. Choose the P1 [Password] parameter.

4. Type the password.

5. Choose the P6 [Operating Mode] parameter.

   The default value is 0, which equals Program.

6. If the relay is in Run mode (Operating Mode parameter equals 1), set the Operating Mode parameter to 0 to enable you to enter a new configuration.

7. If you want to configure a password or change the password, choose the P13 [New Password] parameter.

   The default value is 0. Enter a value from 0…4,294,967,295.

8. Type the new password value.

9. Choose the P17 [Password Command] parameter.

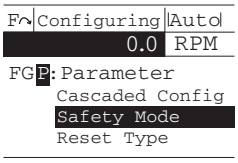
10. Set the Password Command parameter value to 1, which equals Change Password (Change PW).

11. Go to the next section to set the parameters found in the General parameters group.

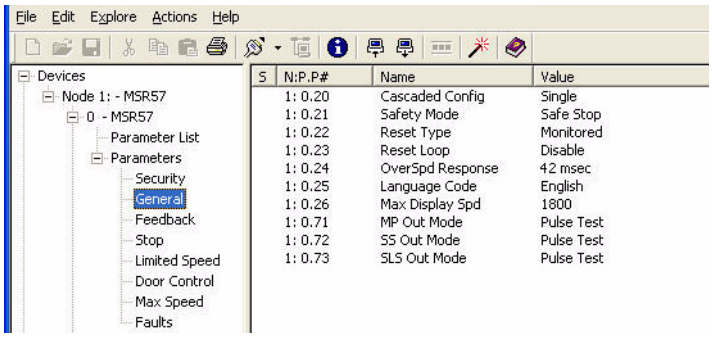
Example 2: General Group Settings

General Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the general operation of the relay.

1. From the General group, choose the P20 [Cascaded Config] parameter.

2. Set the Cascaded Config parameter to 0 (default) to configure the relay as a Single unit.

3. Choose the P21 [Safety Mode] parameter.

   The default setting is 1, which equals Safe Stop.

4. Set the Safety Mode parameter value to 6 for Master, Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring mode (Lim Speed DM ES).

   In this mode, the door is locked when the machine speed is above a configured Safe Speed Limit. The door can be unlocked when a stop has been requested and the machine is at Standstill Speed. The door can also be unlocked when Safe Limited Speed monitoring (SLS_In input = OFF) and the speed is below the configured Safe Speed Limit. When the enabling switch is held in the middle position, the door can be opened while the machine is running below the Safe Speed Limit.

5. Choose the P22 [Reset Type] parameter.

6. Set the Reset Type parameter value to 2 (default), which equals Manual Monitored (Monitored).

   The Manual Monitored setting requires an closing and opening of the reset circuit for a reset.

7. Choose the P23 [Reset Loop] parameter.

8. Set the Reset Loop parameter value to 0 (default) to disable reset qualification monitoring.

   This setting assumes that there are no external contactors or devices connected to the system which require monitoring.

9. Choose the P24 [OverSpd Response] parameter.

   The default Overspeed Response time is 42 ms.

10. Set the OverSpd Response parameter value to 0, which equals 42 ms.

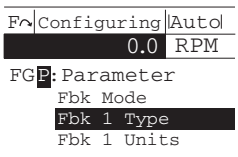
    See Overspeed Response Time on page 75 for details.

11. Go to the next section to configure the type of feedback by using the Feedback parameters group.

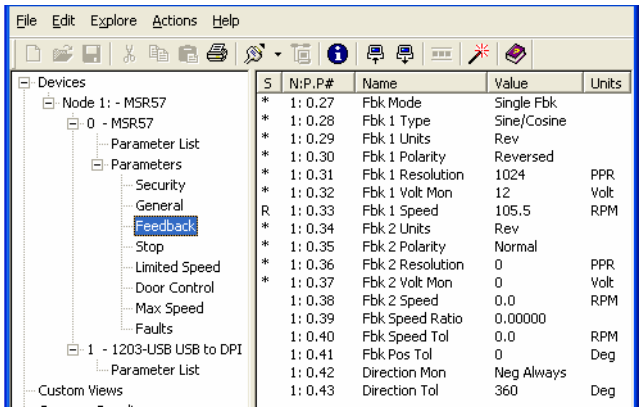
Example 2: Feedback Group Settings

Feedback Group Parameters

HIM Screen



Software Screen


File Edit Explore Actions Help
Devices
Node 1: - MSR57
0 - MSR57
Parameter List
Parameters
Security
General
Feedback
Stop
Limited Speed
Door Control
Max Speed
Faults
1 - 1203-USB USB to DPI
Parameter List
Custom Views
S N:P.P# Name Value Units
* 1: 0.27 Fbk Mode Single Fbk
* 1: 0.28 Fbk 1 Type Sine/Cosine
* 1: 0.29 Fbk 1 Units Rev
* 1: 0.30 Fbk 1 Polarity Reversed
* 1: 0.31 Fbk 1 Resolution 1024 PPR
* 1: 0.32 Fbk 1 Volt Mon 12 Volt
R 1: 0.33 Fbk 1 Speed 105.5 RPM
* 1: 0.34 Fbk 2 Units Rev
* 1: 0.35 Fbk 2 Polarity Normal
* 1: 0.36 Fbk 2 Resolution 0 PPR
* 1: 0.37 Fbk 2 Volt Mon 0 Volt
1: 0.38 Fbk 2 Speed 0.0 RPM
1: 0.39 Fbk Speed Ratio 0.00000
1: 0.40 Fbk Speed Tol 0.0 RPM
1: 0.41 Fbk Pos Tol 0 Deg
1: 0.42 Direction Mon Neg Always
1: 0.43 Direction Tol 360 Deg

Follow these steps to configure the type of feedback used by the relay.

1. From the Feedback group, choose the P27 [Fbk Mode] parameter.
2. Set the Fbk mode parameter value to 0 (default) for redundant processing and cross-checking of the single encoder input in a 1oo2 architecture.
3. Choose the P28 [Fbk 1 Type] parameter.

   The default value is 1 for incremental encoder input.
4. Set the Fbk 1 Type parameter value to 0 for Sine/Cosine and internal monitoring of the single encoder input.
5. Choose the P29 [Fbk 1 Units] parameter.
6. Set the Fbk 1 Units parameter to 0 (default), which equals Rotary feedback.
7. Choose the P30 [Fbk 1 Polarity] parameter.
8. Set the Fbk 1 Polarity parameter to 0 (default) to set up the direction for monitoring to be the same as the encoder direction (Normal).
9. Choose the P31 [Fbk 1 Resolution] parameter.
10. Choose 1024 (default) or enter value between 1…65,535 pulses/revolution based on the encoder's specifications.
11. Choose the P32 [Fbk 1 Volt Mon] parameter.
12. Enter 5, 9, 12, or 14V to monitor voltage in accordance with the encoder's specifications, or enter 0 (default) to disable encoder voltage monitoring

TIP The P33 [Fbk 1 Speed] parameter displays the output speed of the encoder as a value between -214,748,364.8…214,748,364.8 rpm based on the encoder's configuration. You do not need to enter a setting or value for this parameter.

13. Choose the P42 [Direction Mon] parameter.
14. Set the Direction Mon parameter value to 2, to set up the normal monitored direction as Negative Always.

15. Choose the P43 [Direction Tol] parameter.

16. Enter value between 0…65,535 degrees based on the encoder's specifications.

    The default value is 10 degrees.

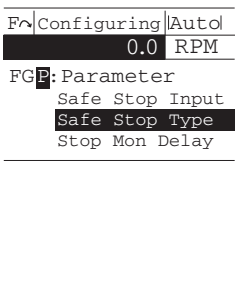
    This sets the position limit tolerated in the wrong direction when Safe Direction Monitoring is enabled. Entering 360 equals one revolution in the forward direction before a Direction Fault occurs.

17. Go to the next section to set the parameters found in the Stop parameters group.

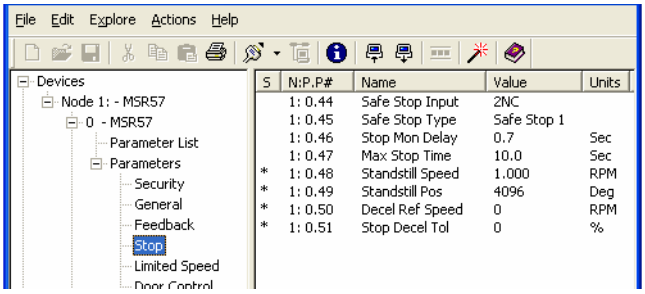
Example 2: Stop Group Settings

Stop Group Parameters

HIM Screen



Software Screen


File Edit Explore Actions Help
Devices
Node 1: - MSR57
0 - MSR57
Parameter List
Parameters
Security
General
Feedback
Stop
Limited Speed
S N:P.P# Name Value Units
1: 0.44 Safe Stop Input 2NC
1: 0.45 Safe Stop Type Safe Stop 1
1: 0.46 Stop Mon Delay 0.7 Sec
1: 0.47 Max Stop Time 10.0 Sec
* 1: 0.48 Standstill Speed 1.000 RPM
* 1: 0.49 Standstill Pos 4096 Deg
* 1: 0.50 Decel Ref Speed 0 RPM
* 1: 0.51 Stop Decel Tol 0 %

Follow these steps to configure the Stop operation of the relay.

1. From the Stop group, choose the P44 [Safe Stop Input] parameter.

2. Set the Safe Stop Input parameter value to 1 (default) for 2NC (dual-channel equivalent) operation.

   In this example application, the Safe Stop input (SS_In) monitors an E-Stop button with two normally-closed (2NC) contacts.

3. Choose the P45 [Safe Stop Type] parameter.

4. Set the Safe Stop Type parameter value to 1, which equals Safe Stop 1.

   Safe Stop 1 monitors deceleration profiles. When Standstill Speed is detected within the Stop Delay [Max Stop Time], the relay switches off Motion Power and sets door control logic to Unlock.

5. Choose the P47 [Max Stop Time] parameter.

   The default value is 0 s, but you can enter a value from 0…6553.5 s.

6. Type the value of the expected ramp to stop time plus a reasonable tolerance after the Safe Stop command is initiated.

   If the machine's speed is not below the Standstill Speed within the Stop Delay [Max Stop Time] you entered, a Stop Speed Fault occurs and door control logic remains set to Lock until Standstill Speed is reached.

7. Choose the P48 [Standstill Speed] parameter.

   The default value is 0.001 rpm, but you can enter a value from 0.001…65,535 rpm. The Standstill Speed is measured in revolutions per minute, because the P29 [Fbk 1 Units] parameter is configured for Rotary feedback.

8. Enter a value in the Standstill Speed parameter field to define the period of time that must pass with no relative position change before the relay determines standstill has been reached.

9. Choose the P49 [Standstill Pos] parameter.

   The default value is 10 degrees, but you can enter a value from 0…65,535 degrees. The Standstill Position is measured in degrees because the P29 [Fbk 1 Units] parameter is configured for Rotary feedback.

10. Enter the value to define the position limit in encoder units that is tolerated after standstill has been reached.

11. Choose the P50 [Decel Ref Speed] parameter.

    The default value is 0 RPM, but you can enter a value from 0…65,535 RPM. The Decel Ref Speed parameter is used to verify that the speed is decelerating at the desired rate.

12. Enter a number greater than the Max Speed (2000 in this example).

13. Choose the P51 [Stop Decel Tol] parameter.

    The Stop Decel Tol parameter determines the total percentage of the Decel Ref Speed that is used as the upper limit of deceleration speed.

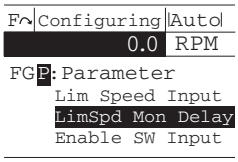
14. Enter 100% for this example.

15. Go to the next section to set the parameters found in the Limited Speed parameters group.

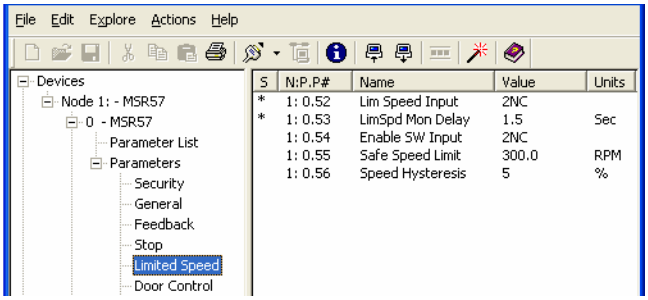
Example 2: Limited Speed Group Settings

Limited Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure the Safe Limited Speed operation.

1. From the Limited Speed group, choose the P52 [Lim Speed Input] parameter.

   The default value is 0 (Disabled), for applications without Safe Limited Speed control.

2. Set the Lim Speed Input parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the Safe Limited Speed input (SLS_In) monitors a switch with two normally-closed (2NC) contacts. If the NC contacts are open and speed exceeds the configured Safe Limited Speed, the relay initiates the configured Safe Stop Type.

   When the relay is actively monitoring Safe Limited Speed and the machine's speed is at or below the configured Safe Speed Limit, the gate interlock is released and the door can be opened.

3. Choose the P53 [LimSpd Mon Delay] parameter.

   The default value is 0 s. The valid range is from 0…6553.5 s.

   Type a value to define the desired delay between the SLS_In input ON to OFF transition and the start of Safe Limited Speed monitoring.

4. Choose the P54 [Enable SW Input] parameter.

   The default value is 0 (Not Used) for applications without an enabling switch.

5. Set the Enable SW Input parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the ESM_In input monitors an enabling switch with two normally-closed (2NC) contacts. As long as the enabling switch is held in the middle position, the safety gate can be opened during Safe Limited Speed monitoring.

6. Choose the P55 [Safe Speed Limit] parameter.

   The default value is 0 rpm or mm/s. Enter a value from 0…6553.5.

7. Type the maximum allowable rpm value for safe (reduced) velocity.

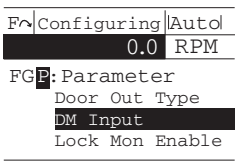
   The speed is calculated in rpm, based on the Fbk 1 Units parameter setting (0 = Rotary feedback) entered previously.

8. Go to the next section to set the parameters that configure Door Control operation.

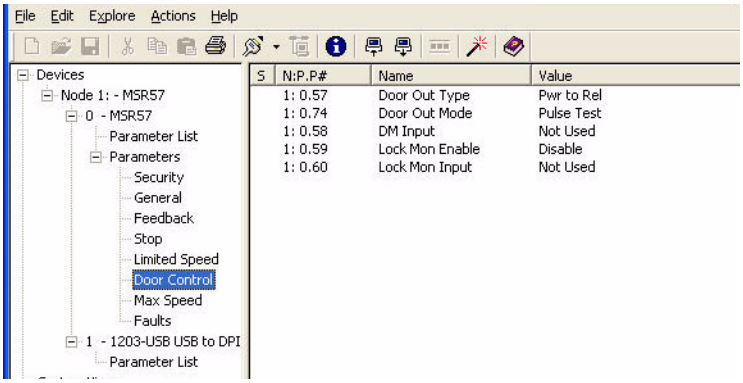
Example 2: Door Control Group Settings

Door Control Group Parameters

HIM Screen



Software Screen



Follow these steps to configure Door Control operation for the relay.

1. From the Door Control group, choose the P57 [Door Out Type] parameter.

2. Set the Door Out Type parameter to 0 (default), which equals Power to Release (Pwr to Rel).

   This setting was chosen because power must be applied to the solenoid inside the TLS-3 GD2 gate switch to release the gate interlock.

3. Choose the P58 [DM Input] parameter.

   The default setting is 0 for applications that do not use an interlock switch.

4. Set the DM Input parameter value to 1 for 2NC (dual-channel equivalent) operation.

   In this example application, the DM Input (DM_In) monitors the TLS-3 GD2 switch, which has two normally-closed (2NC) safety contacts.

5. Choose the P59 [Lock Mon Enable] parameter.

   The default value is 0 (Disabled) for applications without an interlock switch.

6. Set the Lock Mon Enable parameter value to 1 (Enabled) because this application uses the TLS-3 GD2 interlock switch.

7. Choose the P60 [Lock Mon Input] parameter.

   The default value is 0 (Not Used) for applications that do not use an interlock switch.

8. Set the Lock Mon Input parameter value to 1 for 2NC (dual-channel equivalent) operation.

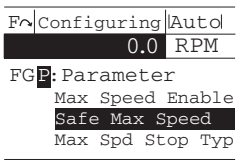
   In this example application, the Lock Monitor Input (LM_In) monitors the TLS-3 GD2 switch, which has two normally-closed (2 N.C.) interlock monitoring contacts.

9. Go to the next section to set the parameters that configure Safe Maximum Speed monitoring.

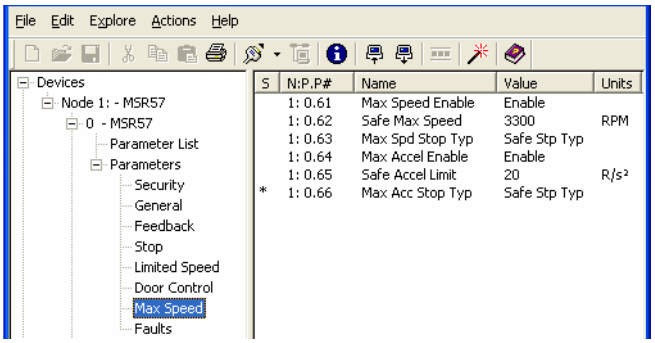
Example 2: Max Speed Group

Max Speed Group Parameters

HIM Screen



Software Screen



Follow these steps to configure Maximum Speed monitoring for the relay.

1. From the Max Speed group, choose the P61 [Max Speed Enable] parameter.

   The default value is 0 (Disabled) for no maximum speed limitation.

2. Set the Max Speed Enable parameter value to 1 (Enabled), which monitors that the encoder feedback signal does not exceed the velocity configured using the Safe Max Speed parameter.

3. Choose the P62 [Safe Max Speed] parameter.

   The default value is 0 rpm or mm/s. Enter a value from 0…6553.5.

4. Type the maximum allowable rpm value for velocity.

   The speed is calculated in rpm, based on the Fbk 1 Units parameter setting (0 = Rotary feedback) entered previously.

5. Choose the P63 [Max Spd Stop Typ] parameter.

6. Set the Max Spd Stop Typ parameter value to 1, which equals Use Configured Safe Stop Type (Safe Stp Typ).

   With this configuration, if speed exceeds the configured Safe Max Speed, the relay initiates the configured Safe Stop Type.

7. Go on to the next section to put the relay into Run mode and lock the configuration.

Example 2: Final Security Group Settings

This example only includes the steps for entering a configuration using the HIM module or software program. You must also follow the requirements described in Chapter 10, Safety Configuration and Verification.

ATTENTION

You must verify the configuration and validate the entire system, including a complete functional test, before the operational startup of any safety-related system.

Only authorized, specially-trained personnel, experienced in the commissioning and operation of safety-related systems may configure, test, and confirm the project.

Follow these steps to put the relay into Run mode, generate a configuration signature, and lock the configuration.

1. From the Security group, choose the P6 [Operating Mode] parameter.

2. Set the Operating Mode parameter value to 1, which equals Run mode.

   A configuration signature is generated.

3. Choose the P10 [Signature ID] parameter and record the configuration signature value stored in this parameter.

4. If you configured a password, choose the P1 [Password] parameter and type the password.

5. Choose the P5 [Lock State] parameter.

6. Set the Lock State parameter value to 1 (Lock) to lock the configuration.

The Config Lock status indicator is solid yellow when the relay configuration is locked.

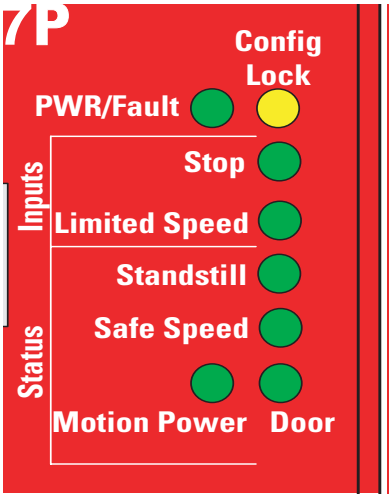
Troubleshoot the MSR57P Relay

Introduction

Topic	Page
Status Indicators	185
Nonrecoverable Faults	186
Fault Recovery	187
Input and Output Faults	187
Fault Codes and Descriptions	187
Fault Reactions	190
Status Attributes	192

Status Indicators

The MSR57P relay features eight indicators to provide status information.



Indicator	Status	Description
PWR/Fault[1]	Green/On	The relay is operating normally and is in Run mode.
	Red/Flashing	A recoverable fault has occurred.
	Red/On	A nonrecoverable fault has occurred. (All other indicators are OFF.)
	Red/Green Flashing	The configuration is being downloaded or a firmware upgrade is in progress.
Config Lock[1]	Yellow/On	The relay's configuration is locked.
	Yellow/Flashing	The relay's configuration is unlocked.
Stop	Green/On	The Safe Stop (SS) input is closed.
	Red/On	The SS input is open or pressed.
	Red/Flashing	The SS input has a fault.
Limited Speed	Green/On	The Safe Limited Speed (SLS) input is closed for normal Run operation.
	Green/Flashing	The SLS input is open for a safe speed request to allow access to the machine (Maintenance operation).
	Off	The SLS function is not configured.
	Red/Flashing	The SLS input has a fault.

Indicator	Status	Description
Motion Power	Green/On	The Motion Power (MP) output is ON.
	Off	The MP output is OFF.
	Red/Flashing	The MP output has a fault.
Door[2]	Green/On	The door is closed.
	Red/On	The door is open.
	Red/Flashing	Door Monitor or Lock Monitor input switch has a fault.
	Off	Door monitoring is not configured.
Safe Speed[3]	Green/On	Safe Limited Speed is being actively monitored and is below the configured Safe Limited Speed value after an SLS request has been made.
	Off	Safe Limited Speed is not being monitored.
	Red/Flashing	An SLS Speed Fault has occurred.
Standstill	Green/On	Standstill Speed has been detected.
	Off	Speed is greater than the configured Standstill Speed.
	Red/Flashing	Motion has been detected after stopped condition or a Stop Speed Fault has occurred.

(1) PWR/Fault green indicator and Config Lock indicator flash in synch when the relay is in Program mode.
(2) In cascading applications, the status of the door is only indicated by the Door indicator on the master unit. The Door status indicators on middle and last units remain OFF.
(3) When the relay is configured for Slave, SLS Status Only mode, the Safe Speed indicator is solid green when the monitored speed of an individual MSR57P unit is below the Safe Speed Limit, following hysteresis. The Safe Speed indicator is OFF when the monitored speed is above the configured safe speed limit. In this mode, the SLS_In value does not affect the state of the Safe Speed indicator.

When you apply power to the relay, the red/green indicators flash alternate colors and the Config Lock indicator flashes on and off twice before all indicators except for the PWR/Fault indicator turn off. The PWR/Fault indicator remains flashing until the relay enters Run or Program mode.

Nonrecoverable Faults

In addition to the reportable faults described in this chapter, the relay also generates nonrecoverable faults when a problem with the relay hardware is detected. These faults are Safe State Faults. If a Safe State Fault occurs, all safety control outputs are set to their safe state.

To clear a nonrecoverable fault, cycle power. If the nonrecoverable fault persists, the relay may need to be replaced.

Fault Recovery

If the fault is no longer present, the fault condition may be cleared by a successful SS Reset, except in the case of an Invalid Configuration Fault, MP Out Fault, or Reset On At PwrUp Fault. An Invalid Configuration Fault is cleared by a successful reconfiguration. An MP Out Fault or Reset On At PwrUp Fault is cleared at power down or by a successful reconfiguration.

Input and Output Faults

An input or output fault indication can be caused by several wiring fault conditions during commissioning or normal operation. If an input fault occurs, check for the following:

- One of the channels may have shorted to a 24V DC source.
- One of the channels may have shorted to a GND source.
- Two input channels have shorted together.
- One or both output channels have an overcurrent condition.

An input fault may also occur if only one of the channels in a dual-channel system changed state after a 3-second discrepancy time interval, if the inputs are configured with one of the following settings.

- 2 = Dual-channel equivalent 3 s (2NC 3s)
- 4 = Dual-channel complementary 3 s (1NC + 1NO 3s)
- 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s)

Fault Codes and Descriptions

Faults fall into one of three categories: Stop Category Fault, Fault While Stopping Fault, and Safe State Fault. Stop Category Faults can be Motion Faults, Monitor Faults, or I/O Faults.

The HIM module or configuration software can display a fault history queue, which provides a record of the faults detected by the relay. The fault history queue stores the fault codes and timestamps for the last 10 faults that occurred. To avoid confusion about when faults occurred, a power up marker (code 32) is placed between faults in the queue if the relay is powered up or reset when the queue is not empty. Code 0 equals No Entry.

The following tables list the faults, fault codes, and display text for the faults. These faults can be viewed by accessing the P67 [Fault Status] parameter.

See Appendix C for information on using a HIM to access the fault history queue. See Appendix D for information on using DriveExplorer software to access the fault history queue.

Safe State Faults

Code	Display Text	Description
0	Combined Flt	A combined fault is indicated if any error has occurred.
1	Core Error	A nonrecoverable microprocessor error has occurred.
2	Invalid Cfg	An Invalid Configuration fault occurs if a configuration parameter is set to an illegal value or combination of values. See the Configuration Fault Codes on page 196.
3	MP Out Flt	An MP Output Fault indicates an error in the MP_Out output.
4	Reset PwrUp	A Reset Power Up fault occurs if the reset type is configured for Manual or Manual Monitored and the Reset_In input is detected as ON when power is cycled.
5	Fbk 1 Flt	A Feedback 1 Fault occurs if any of the following conditions are detected at encoder 1: • An open wire is detected. • A short-circuit is detected. • A sine/cosine fault exists, that is the amplitude of the sine signal squared plus the amplitude of the cosine signal squared is not equal to a constant value. • The feedback signals indicate a frequency greater than or equal to 100 kHz for a Sine/cosine encoder or 200 kHz for a incremental encoder. • Illegal encoder signal transitions are detected.
6	Fbk 2 Flt	A Feedback 2 Fault occurs if any of the following conditions are detected at encoder 2: • Illegal encoder signal transitions are detected. • The feedback signals indicate a frequency greater than or equal to 200 kHz.
7	Dual Fbk Spd	A Dual Feedback Speed fault occurs if an error is detected between the speed from the first encoder and the speed from the second encoder. Valid speed-comparison values are determined by the configured Feedback Speed Ratio and Feedback Speed Tolerance.
8	Dual Fbk Pos	A Dual Feedback Position fault occurs if a discrepancy is detected between the relative position change of the encoder 1 and the relative position change of encoder 2 since the last SS Reset.
13	Mov in Stop	If the relay is configured for a stop type that includes stopped speed checking, a Move in Stop fault occurs if either of the following is detected after the system is stopped and the door has been unlocked: • speed greater than the configured Standstill Speed • a position change greater than the configured Standstill Position limit
27	Fbk 1 V Fault	An Encoder 1 Voltage Fault occurs if the encoder voltage at encoder 1 is detected as out of range.
28	Fbk 2 V Fault	An Encoder 2 Voltage Fault occurs if the encoder voltage at encoder 2 is detected as out of range.

Fault While Stopping Faults

Code	Display Text	Description
11	Decel Flt	A Deceleration Fault occurs if the speed is detected at greater than the limit specified for the configured Stop Delay [Max Stop Time] when the configured Safe Stop Type is Safe Stop 1 or 2.
12	Stop Spd Flt	A Stop Speed Fault occurs when the relay is configured for a Safe Stop Type that includes Standstill Speed checking (Safe Stop 1 or 2, and Safe Torque Off with Standstill Speed Checking) and the detected speed is greater than the configured Standstill Speed at the end of the configured Stop Delay [Max Stop Time].

Stop Category Fault Descriptions

Code	Display Text	Description	
9	SS In Flt	I/O Faults[1]	An SS_In Fault occurs if an error is detected in the SS_In dual-channel input.
10	SS Out Flt		An SS_Out Fault occurs if an error is detected in the SS_Out dual-channel output.
14	SLS In Flt		An SLS_In Fault occurs if an error is detected in the SLS_In dual-channel input.
15	SLS Out Flt		An SLS_Out Fault occurs if an error is detected in the SLS_Out dual-channel output.
20	DM In Flt		A DM_In Fault occurs if an error is detected in the DM_In dual-channel input.
22	DC Out Flt		A DC_Out Fault occurs if an error is detected in the DC_Out dual-channel output.
23	LM In Flt		An LM_In Fault occurs if an error is detected in the LM_In dual-channel input.
25	ESM In Flt		An ESM_In Fault occurs if an error is detected in the ESM_In dual-channel input.
16	SLS Speed Flt	Motion Faults	The monitored speed was detected at greater than or equal to the Safe Speed Limit during Safe Limited Speed monitoring.
17	SMS Spd Flt		A Safe Maximum Speed Fault indicates that Safe Maximum Speed (SMS) monitoring is enabled and the monitored speed was detected at greater than or equal to the configured Safe Max Speed.
18	Accel Flt		An Acceleration Fault indicates that the monitored speed was detected as greater than or equal to the configured Safe Accel Rate during safe acceleration monitoring.
19	Dir Flt		A Direction Fault indicates that motion was detected in the restricted direction during safe direction monitoring (SDM).

Stop Category Fault Descriptions

Code	Display Text	Description	
21	Door Mon Flt	Monitor Fault	If the relay is configured for Safe Limited Speed (SLS), but SLS monitoring is not active, the DM_In input must be ON (door closed) or a Door Monitoring Fault occurs. A Door Monitoring Fault occurs if the door is open (DM_In input is OFF) when an SS Reset or SLS Reset is requested (SLS_In transitions to ON). If a configured SLS Monitoring Delay [Lim Spd Mon Delay] is in progress prior to Safe Limited Speed monitoring being active and the DM_In input is OFF (door open), a Door Monitoring Fault occurs. If the relay is configured for door monitoring and enabling switch monitoring and is actively monitoring safe limited speed, a Door Monitoring Fault occurs if the DM_In input transitions from ON to OFF (door is opened), while the ESM_In input is OFF.
26	ESM Mon Flt		If the relay is configured for enabling switch monitoring and is actively monitoring safe limited speed, the ESM_In input must be ON or an ESM Monitoring Fault occurs. If the relay is configured for enabling switch monitoring only and a configured SLS monitoring delay [Lim Spd Mon Delay] is in progress, the ESM_In input must be ON when the delay times out or an ESM Monitoring Fault occurs. If the ESM_In input is ON while the relay is actively monitoring safe limited speed, the door can be opened (DM_In transitions from ON to OFF) if no Lock Monitoring Fault exists. However, if the ESM_In input transitions to OFF after the door has been opened, an ESM Monitoring Fault occurs. If you attempt an SS Reset while the SLS_In input is OFF and the ESM_In input is OFF, an ESM Monitoring Fault occurs.
24	Lock Mon Flt		If the relay is configured for lock monitoring, a Lock Monitoring Fault occurs when: • the LM_In input is detected as OFF while the door control output is in the Lock state, except for the 5 seconds following the transition of the DC_Out output from Unlock to Lock. • the LM_In input is detected as ON when the DM_In signal transitioned from ON to OFF.
29	RL Flt		An RLM Reset Fault occurs if the MSR57P relay is configured to qualify an SS Reset with the RL_In input and an SS Reset is attempted when the MP_Out output is OFF and the RL_In input is OFF.

(1) For more information on these faults see Input and Output Faults on page 187.

Fault Reactions

When a fault occurs, the type of fault and the status of the system determine the resulting state of the system.

Safe State Faults

If a Safe State Fault occurs in any operational state including the Disabled state, the relay goes to the Safe State. In the Safe State, all safety outputs are in their safe states.

Stop Category Faults and Fault While Stopping Faults

If a Stop Category Fault or Fault While Stopping Fault occurs while the relay is monitoring motion, the relay initiates the configured Safe Stop Type.

The type of fault detected determines the relay's response when the fault occurs while the relay is executing the configured Safe Stop Type.

Faults Detected While Executing a Safe Stop

Type of Fault	Response
Fault While Stopping Faults: • Deceleration Fault (Decel Flt) • Stop Speed Fault (Stop Spd Flt)	Outputs are placed in a faulted state, but door control logic can be set to Unlock if feedback signals indicate that Standstill Speed has been reached. The relay continues to monitor for faults.
These Stop Category Faults: • SMS Speed Fault when the P63 [Max Spd Stop Typ] is configured for Use Safe Torque Off with Check for Standstill (Torque Off) • Acceleration Fault when the P66 [Max Acc Stop Typ] is configured for Use Safe Torque Off with Check for Standstill (Torque Off) • Direction Fault (Dir Flt), if the fault occurred while a safe stop was in progress.	
These Stop Category Faults: • SLS Speed Fault (SLS Spd Flt) • Direction Fault (Dir Flt), if the fault was detected before the safe stop was initiated. In this case, the relay does not perform Direction Monitoring while executing the configured Safe Stop Type. • Door Monitoring Fault (Door Mon Flt) • ESM Monitoring Fault (ESM Mon Flt) • Lock Monitoring Fault (Lock Mon Flt) • RLM Reset Fault (RL Flt) • SMS Speed Fault when the P63 [Max Spd Stop Typ] is configured for Use Configured Safe Stop Type (Safe Stp Typ) • Acceleration Fault when the P66 [Max Acc Stop Typ] is configured for Use Configured Safe Stop Type (Safe Stp Typ)	The relay continues to execute the configured Safe Stop Type and monitor for faults.

If outputs are already in a faulted state due to a previous fault, and a subsequent Stop Category Fault or Fault While Stopping Fault occurs, outputs remain in a faulted state, door control logic can be set to Unlock if feedback signals indicate that Standstill Speed has been reached, and the relay continues to monitor for faults.

If a Stop Category Fault or Fault While Stopping Fault occurs after Standstill Speed has been reached and the relay has set door control logic to Unlock, the relay goes to the Safe State.

ATTENTION

If a fault occurs after Standstill Speed has been reached, door control logic may remain unlocked.

A Safe State Fault may set the Door Control output (DC_Out) to OFF.

Status Attributes

For diagnostic purposes only, you can view status attributes by accessing the P68 [Guard Status] parameter and the P69 [IO Diag Status] parameter from a HIM or via DriveExplorer or DriveExecutive software.

The status attributes are only valid when the MSR57P relay is in Run mode. If the MSR57P relay is in Program mode or has an Invalid Configuration Fault, the status attributes are not updated.

Guard Status Attributes

These attributes are stored in the P68 [Guard Status] parameter. Each bit corresponds to a different attribute.

Guard Status

Bit	Display Text	Description
0	StatusOK	This bit indicates when there are no faults. It is set (1), when all of the Fault Status bits 1…31 are 0 (no faults). The bit is 0 if any Fault Status bit from 1…31 indicates a fault (1).
1	Config Lock	This bit shows the status of the P5 [Lock State] parameter. A 1 indicates the configuration is locked; a 0 indicates the configuration is unlocked.
2	MP_Out	This bit is set to 0, if the MP_Out dual-channel output is being commanded to the OFF state. This bit is set to 1 if the MP_Out dual-channel output is being commanded to the ON state.This bit is the commanded value, not the readback value.
3	SS In	This bit displays the logical value, 1 or 0, evaluated for the dual-channel SS_In input.
4	SS Req	This bit is set to 1 when a safe stop is initiated by either a transition of the SS_In input from ON to OFF or by a Stop Category Fault. This bit is reset to 0 when a successful SS Reset occurs and when the Safety Mode is set to Disabled (0).
5	SS In Prog	This bit is set to 1 when a safe stop is initiated by the transition of the SS_In input from ON to OFF with no active fault conditions. It is not set to 1 when a Safe Stop is initiated by a Stop Category Fault. While set to 1, this bit will be reset (0) if Standstill Speed is reached or any fault condition is detected.

Guard Status

Bit	Display Text	Description
6	SS Decel	This bit is set to 1 if the configured Stop Delay [Max Stop Time] is active for a Safe Stop 1 or Safe Stop 2 while the relay is executing the Safe Stop. This bit is not set during a Category 0 Safe Torque Off Safe Stop. This bit is reset (0) when Standstill Speed is detected, a Safe State Fault occurs, or a SS Reset occurs.
7	SS Stopped	This bit is set to 1 if a successful Safe Stop has been executed and the speed is less than or equal to the Standstill Speed. This bit is set to 0 by an SS Reset or the occurrence of a Stop Category Fault. It is always 0 when the relay is configured for a Safe Torque Off without Standstill Speed Checking.
8	SS Out	This bit is set to 1 if the dual-channel SS_Out output is being commanded to the ON state. This bit is the commanded value, not a readback value. This bit is set to 0 if the SS_Out output is being commanded to the OFF state.
9	SLS In	This bit reflects the logical value evaluated for the dual-channel SLS_In input.
10	SLS Req	This bit is set to 1 if the Safe Limited Speed operation has been requested while the relay is actively monitoring motion or a SLS Monitoring Delay [LimSpd Mon Delay] is in progress.
11	SLS In Prog	This bit is set to 1 when Safe Limited Speed monitoring is active.
12	SLS Out	This bit is set to 1 if the dual-channel SLS_Out output is being commanded to the ON state. This bit is the commanded value, not a readback value.
13	SMS In Prog	This bit is set to a 1 if Safe Maximum Speed monitoring is enabled and Safe Maximum Speed is being monitored.
14	SMA In Prog	This bit is set to 1 if Safe Maximum Acceleration monitoring is enabled and safe maximum acceleration is actively being monitored.
15	SDM In Prog	If Safe Direction monitoring is enabled and configured for Positive Always or Negative Always, the SDM_In_Progress bit is set to 1 any time the relay is configured for any Safety Mode other than Disabled. If Safe Direction monitoring is enabled and configured for Positive During SLS or Negative During SLS, then this bit is set to 1 if the relay is actively monitoring for Safe Limited Speed. It is set to 0 in any other operating mode.
16	DC Lock	This bit is set to 1 if door control logic status is Lock. This bit is set to 0 if door control logic status is Unlock.
17	DC Out	This bit is set to 1 if the dual-channel DC_Out output is being commanded to the ON state. This is the commanded value, not the readback value. This bit is set to 0 if the dual-channel DC_Out output is being commanded to the OFF state.
18	DM In	This bit is set to 1 if the logical value of the dual-channel DM_In input is evaluated as 1. This bit is set to 0 if the logical value of the dual-channel DM_In input is evaluated as 0.

Guard Status

Bit	Display Text	Description
19	DM In Prog	The status of this bit is dependent on the relay's speed monitoring configuration. The bit is 1 when: • the relay is configured for Safe Stop with Door Monitoring and is monitoring motion, or is executing a Safe Stop. • the relay is configured for Safe Limited Speed with Door Monitoring and the relay is not actively monitoring for Safe Limited Speed, is in a SLS Monitoring Delay [LimSpd Mon Delay], or is executing a Safe Stop. • the relay is configured for Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring, and – the relay is not actively monitoring for Safe Limited Speed, is in a SLS Monitoring Delay [LimSpd Mon Delay], or is executing a Safe Stop. – the relay is actively monitoring for Safe Limited Speed when the ESM_In input is OFF and the DM_In input is ON. This bit is always set to 0 when the relay is not configured for Door Monitoring.
20	LM In	This bit is set to 1 if the logical value of the dual-channel LM_In input is evaluated as 1. This bit is set to 0 if the logical value of the dual-channel LM_In input is evaluated as 0.
21	ESM In	This bit is set to 1 if the logical value of the dual-channel ESM_In input is evaluated as 1. This bit is set to 0 if the logical value of the dual-channel ESM_In input is evaluated as 0.
22	ESM In Prog	This bit is set to 1 if the Safety Mode is configured for Enabling Switch Monitoring, Safe Limited Speed monitoring is active, and the SLS_In input is OFF. It is also set to 1 if the Safety Mode is configured for Enabling Switch Monitoring and Door Monitoring and the DM_In input is OFF. This bit is set to 0 when the Safety Mode is not configured for Enabling Switch Monitoring.
23	Reset In	This status bit reflects the state of the Reset_In input. A 1 indicates the Reset_In input is ON; a 0 indicates the Reset_In input is OFF.
24	Wait Reset	This bit indicates when an SS Reset is required. The bit is set to 1 whenever the relay is successfully configured and is in the Safe State or when Standstill Speed has been reached.
25	Wait SS Cyc	This bit indicates when the SS_In input must be cycled prior to a SS Reset being performed. The bit is set to 1 if the SS_In input is ON and a fault is detected or the Wait Stop Request attribute equals 1. It is set to 0 if the SS_In input is detected as OFF.
26	Wait No Stop	This bit is set (1) when a stop request is made using the HIM stop button. It is set to 0 when the HIM start button is pushed, following a reset, or at power-up.
27	SLS Cmd	This bit reflects the status of the SLS_Command output. A 1 indicates that the output is ON; a 0 indicates that the output is OFF. See SLS_Command Output on page 71.
28	Stop Cmd	This bit reflects the status of the Stop_Command output. A 1 indicates that the output is ON; a 0 indicates that the output is OFF. See Stop_Command Output on page 70.
29 ⋮ 31	Reserved	

I/O Diagnostic Status Attributes

These attributes are stored in the P69 [I/O Diagnostic Status] parameter. Each bit reflects the present state of I/O signal and is used for diagnostics: 0 = open; 1 = closed.

I/O Diag Status

Bit	Display Text
0	SS In Ch 0
1	SS In Ch 1
2	SS Out Ch 0
3	SS_Out Ch 1
4	SLS In Ch 0
5	SLS In Ch 1
6	SLS Out Ch 0
7	SLS Out Ch 1
8	ESM In Ch 0
9	ESM In Ch 1
10	DM In Ch 0
11	DM In Ch 1
12	DC Out Ch 0
13	DC Out Ch 1
14	LM In Ch 0
15	LM In Ch 1
16	Reset In
17	RL In
18	SLS Cmd
19	Stop Cmd
20	MP Out Ch 0
21	MP Out Ch 1
Bits 22…31 are Reserved (0).	

IMPORTANT When the MSR57P relay is not in Run mode, the P69 [I/O Diagnostic Status] parameter is not updated.

Configuration Fault Codes

Use these fault codes, stored in P70 [Config Flt Code], to identify the reason for an Invalid Configuration Fault.

Value	Description	Display
0	No Fault.	No Fault
1	Password Required.	Password Req
2	Safety Mode (21) value not legal based on Cascaded Config (20) value.	P21 (P20)
3	Door Out Type (57) value not legal based on Cascaded Config (20) value.	P57 (P20)
4	Stop Mon Delay (46) value not legal based on Safe Stop Type (45) value.	P46 (P45)
5	Decel Ref Spd (50) value not legal based on Fbk 1 Resolution (31) value.	P50 (P31)
6	Standstill Speed (48) value not legal based on Cascaded Config (20) value.	P48 (P20)
7	LimSpd Mon Delay (53) value not legal based on Safety Mode (21) value.	P53 (P21)
8	Safe Speed Limit (55) value not legal based on Safety Mode (21) and Fbk 1 Resolution (31) value.	P55 (P21 P31)
9	Speed Hysteresis (56) value not legal based on Safety Mode (21) value.	P56 (P21)
10	Safe Max Speed (62) value not legal based on Fbk 1 Resolution (31) value.	P62 (P31)
11	Direction Mon (42) value not legal based on Safety Mode (21) value.	P42 (21)
12	Lock Mon Enable (59) value not legal based on Safety Mode (21) value.	P59 (P21)
13	Fbk 2 Resolution (36) value not legal based on Fbk Mode (27) value.	P36 (P27)
14	Fbk 2 Polarity (35) value not legal based on Fbk Mode (27) value.	P35 (P27)
15	Fbk Speed Ratio (39) value not legal based on Fbk Mode (27) value.	P39 (P27)
16	Fbk Pos Tol (41) value not legal based on Fbk Mode (27) value.	P41 (P27)
17	Fbk Speed Tol (40) value not legal based on Fbk Mode (27) value.	P40 (P27)
18	Safe Stop In Typ (44) value not legal based on Safety Mode (21) value.	P44 (P21)
19	Lim Speed Input (52) value not legal based on Safety Mode (21) value.	P52 (P21)
20	DM Input Type (58) value not legal based on Cascaded Config (20) and Safety Mode (21) value.	P58 (P 20 P21)
21	Enable SW In Typ (54) value not legal based on Safety Mode (21) value.	P54 (P21)
22	Lock Mon In Type (60) value not legal based on Safety Mode (21) value and Lock Mon Enable (59) value.	P60 (P21, P59)
23	Illegal Cascaded Config (20) value.	P20
24	Illegal Reset Type (22) value.	P22
25	Illegal Reset Loop (23) value.	P23
26	Illegal Safe Stop Type (45) value.	P45
27	Illegal Stop Decel Tol (51) value.	P51
28	Illegal Fbk Mode (27) value.	P27
29	Illegal Fbk 1 Type (28) value.	P28
30	Illegal Fbk 1 Resolution (31) value.	P31
31	Illegal Fbk1 Volt Mon (32) value.	P32
32	Illegal Fbk 2 Volt Mon (37) value.	P37
33	Illegal OverSpd Response (24) value.	P24
34	Illegal MP_Out Mode (71) value.	P71
35	Unknown error.	Unknown Err

Specifications

Introduction

Topic	Page
General Specifications	197
Environmental Specifications	198
Certifications	199
Encoder Specifications	199

General Specifications

Attribute	Value
Standards	IEC/EN60204-1, ISO12100, IEC 61508, IEC 61800-5-2
Safety category	Cat. 4 and PL(e) per EN ISO 13849-1; SIL CL3 per IEC 61508 and EN 62061
Power supply	24V DC, 0.8…1.1 x rated voltage[(2)] PELV or SELV
Aggregate current of MSR57P	10.4 A max @ terminal A1 + 13
Power consumption	5 W
MP outputs 14, 24, SLS outputs 68, 78	24V DC, 2 A, short-circuit protected
SS outputs 34, 44	24V DC, 100 mA, short-circuit protected
SLS_Status output Y35, Fault_Status output Y37	24V DC, 50 mA, short-circuit protected
Door control outputs 51, 52	24V DC, short-circuit protected • 1.5 A, bipolar (Power to Release/Power to Lock) configuration • 20 mA per output, cascading (2Ch Source) configuration
Stop_Command output Y32,	24V DC, 100 mA, short-circuit protected
SLS_Command output Y33	24V DC, 100 mA, short-circuit protected
Output Y1	24V DC, 20 mA, short-circuit protected
Pulse outputs S11, S21	24V DC, 100 mA, short-circuit protected
Pulse inputs S12, S22, S32, S42, S52, S62, S72, S82, X32, X42	11 mA per input, max
Inputs S34, Y2	11 mA per input, max
Input ON Voltage, min	11V
Input OFF Voltage, max	5V
Input OFF Current, max	2 mA

Attribute	Value
Input-to-output response time (SS_In, SLS_In, DM_In, ESM_In, LM_In)	20 ms
Overspeed Response Time	User-configurable
Power-on delay, max	3 s
Pollution degree	2
Enclosure protection	IP40
Terminal protection	IP20
Wire Type	Use copper that will withstand 60/75 °C (140/167 °F)
Conductor size(1)	0.2…2.5 mm^2 (12…24 AWG)
Terminal screw torque	0.6…0.8 Nm (5…7 lb-in)
Case material	Polyamide PA 6.6
Mounting	35 mm DIN rail
Weight, approx.	350 g (0.77 lb)

(1) Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

(2) Safety outputs need additional fuse for reverse voltage protection of the control circuit. Install a 6 A slow-blow or 10 A fast-acting fuse.

Environmental Specifications

Attribute	Value
Temperature, operating	-5…55 °C (23…131 °F)
Relative humidity	90% RH noncondensing
Vibration	10…55 Hz, 0.35 mm displacement
Shock, operating	10 g, 16 ms, 100 shocks
ESD immunity	4 kV contact discharges; 8 kV air discharges
Radiated RF immunity	10 V/m from 80…1000 MHz; 3 V/m from 1.4…2.0 GHz; 1V/m from 2.0…2.7GHz
EFT/B immunity	Power, dc: ±2 kV I/O signal lines: ±1 kV
Surge transient immunity	Power, dc: ±0.5 kV line-line and ±0.5 kV line-earth I/O signal lines: ±1 kV line-earth
Conducted RF immunity	10V rms from 150 kHz…80 MHz
Radiated Emissions	Group 1, Class A

Certifications

Certification[1]	Value
c-UL-us	UL Listed, certified for US and Canada.
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-4; Industrial Emissions. • EN 61131-2 Programmable Controllers (Clause 8, Zone A & B). • EN 61326-3-1; Meas./Control/Lab., Industrial Requirements. • EN 61000-6-2; Industrial Immunity.
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions.
TÜV	TÜV Certified for Functional Safety: up to SIL CL3, according to IEC 61508 and EN 62061; up to Performance Level PL(e) and Category 4, according to EN ISO 13849-1; when used as described in this Guardmaster MSR57P Speed Monitoring Safety Relay User Manual, publication 440R-UM004.

(1) When product is marked.

See the Product Certification link at http://ab.com for Declarations of Conformity, Certificates, and other certifications details.

Encoder Specifications

Type	Parameter	Description
Generic Incremental	TTL incremental encoder support	5V, differential A quad B
	Differential input voltage (AM and BM)	1.0…7.0V
	Input signal frequency (AM and BM)	200 kHz, max
Generic Sin/Cos	AM/BM differential input voltage (p-p)	0.6…1.2V
	AM/BM input frequency	100 kHz, max
Stegmann Sin/Cos	AM/BM differential input voltage (p-p)	1V ±10%
	AM/BM input frequency	100 kHz, max

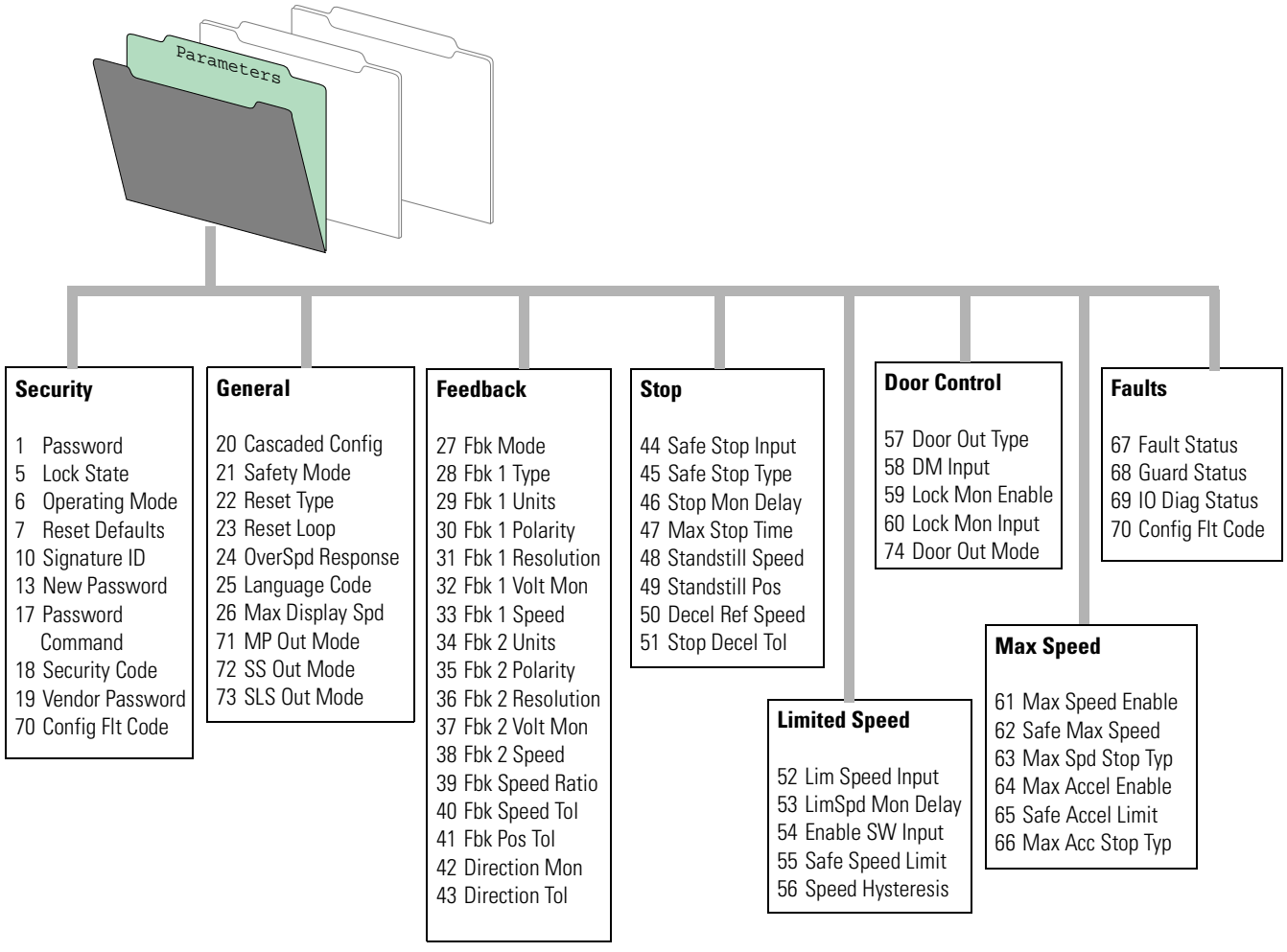
Parameter Data

Parameters are organized into both a linear list by parameter number, and into device-specific files and groups.

Parameter Groups

Parameters for the speed monitoring safety relay appear in the groups Security, General, Feedback, Stop, Limited Speed, Door Control, Max Speed, and Faults.

MSR57P Parameter Groups



Parameters and Settings in a Linear List

The table lists the configurable parameters and their valid settings in numerical order. If any values other than those listed in the table are configured for any of the parameters, an Invalid Configuration Fault occurs.

List of Parameters

No.	Name	Description	Values	Read/ Write
1	Password	Password for Lock and Unlock function.	Range: 0…4,294,967,295	R
2	Reserved			
3				
4				
5	Lock State	Command to lock or unlock the relay configuration.	Default: 0 = Unlock	R/W
			Options: 0 = Unlock 1 = Lock	
6	Operating Mode	Command to place the system in Program or Run mode.	Default: 0 = Program	R/W
			Options: 0 = Program 1 = Run 2 = Config flt	
7	Reset Defaults	Resets relay to factory defaults.	Options: 0 = No action 1 = Reset to factory defaults (Reset Fac)	R/W
8	Reserved			
9				
10	Signature ID	Safety configuration identifier.	Range: 0…4,294,967,295	R
11	Reserved			
12				
13	New Password	32-bit configuration password.	Range: 0…4,294,967,295	W
14	Reserved			
15				
16				
17	Password Command	Save new password command.	Default: 0 = No action	R/W
			Options: 0 = No action 1 = Change Password (Change PW) 2 = Reset Password (Reset PW)	
18	Security Code	Used for Reset Password command.	Range: 0…65,535	R
19	Vendor Password	Vendor password for Reset Password command.	Range: 0…65,535	R/W
20	Cascaded Config	Defines whether the speed monitoring relay is a single unit or if it occupies a first, middle, or last position in a multi-axis cascaded system.	Default: 0 = Single Unit System (Single)	R/W
			Options: 0 = Single Unit System (Single) 1 = Cascaded System First Unit (Multi First) 2 = Cascaded System Middle Unit (Multi Mid) 3 = Cascaded System Last Unit (Multi Last)	

List of Parameters

No.	Name	Description	Values	Read/ Write
21	Safety Mode	Defines the primary operating mode of the speed monitoring safety functions.	Default: 1 = Master, Safe Stop (Safe Stop) Options: 0 = Disabled 1 = Master, Safe Stop (Safe Stop) 2 = Master, Safe Stop with Door Monitoring (Safe Stop DM) 3 = Master, Safe Limited Speed (Lim Speed) 4 = Master, Safe Limited Speed with Door Monitoring (Lim Speed DM) 5 = Master, Safe Limited Speed with Enabling Switch Control (Lim Speed ES) 6 = Master, Safe Limited Speed with Door Monitor and Enabling Switch (LimSpd DM ES) 7 = Master, Safe Limited Speed Status Only (Lim Spd Stat) 8 = Slave, Safe Stop (Slv Safe Stp) 9 = Slave, Safe Limited Speed (Slv Lim Spd) 10 = Slave, Safe Limited Speed Status Only (Slv Spd Stat)	R/W
22	Reset Type	Defines the type of reset used by the safety relay.	Default: 2 = Manual Monitored (Monitored) Options: 0 = Automatic 1 = Manual 2 = Manual Monitored (Monitored)	R/W
23	Reset Loop	Defines whether the Reset Loop input (RL_In) is used to qualify a Safe Stop Reset.	Default: 0 = Always Qualified (Disable) Options: 0 = Always Qualified (Disable) 1 = Qualified by RL_In (Enable)	R/W
24	OverSpd Response	Configuration for the feedback interface sampling rate.	Default: 0 = 42 ms Options: 0 = 42 ms 1 = 48 ms 2 = 60 ms 3 = 84 ms 4 = 132 ms 5 = 228 ms 6 = 420 ms	R/W
25	Language Code	Determines the language of the parameter display.	Default: 0 = English Options: 0 = English 1 = French 2 = Spanish 3 = Italian 4 = German 5 = Reserved 6 = Portuguese 7 = Reserved 8 = Reserved 9 = Dutch	R/W
26	Max Display Spd	Determines scaling for Fbk 1 speed process display value.	Default: 1800 Range: 1…65,535 rpm or mm/s	R/W
27	Fbk Mode	Selects the number of encoders and the type of discrepancy checking.	Default: 0 = 1 Encoder (Single Fbk) Options: 0 = 1 Encoder (Single Fbk) 1 = 2 Encoders with Speed and Position Discrepancy Checking (Dual S/P Chk) 2 = 2 Encoders Speed Discrepancy Checking (Dual Spd Chk) 3 = 2 Encoders Position Discrepancy Checking (Dual Pos Chk)	R/W
28	Fbk 1 Type	Selects the type of feedback for encoder 1.	Default: 1 = TTL (Incremental) Options: 0 = Sine/Cosine 1 = TTL (Incremental)	R/W
29	Fbk 1 Units	Selects rotary or linear feedback for encoder 1.	Default: 0 = Rotary (Rev) Options: 0 = Rotary (Rev) 1 = Linear (mm)	R/W
30	Fbk 1 Polarity	Defines the direction polarity for encoder 1.	Default: 0 = Same as encoder (Normal) Options: 0 = Same as encoder (Normal) 1 = Reversed	R/W

List of Parameters

No.	Name	Description	Values	Read/ Write
31	Fbk 1 Resolution	Counts/Revolution.	Default: 1024 Range: 1…65,535 pulses/revolution or pulses/mm based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter	R
32	Fbk 1 Volt Mon	Encoder 1 voltage to be monitored.	Default: 0 = Voltage not monitored Options: 0 = Voltage not monitored 5 = 5V ±10% 9 = 7…12V 12 = 11…14V 14 = 11.5…15.5V	R/W
33	Fbk 1 Speed	Displays the output speed of encoder 1	Range: -214,748,364.8…214,748,364.7 rpm or mm/s based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter	R
34	Fbk 2 Units	Selects rotary or linear feedback system for encoder 2.	Default: 0 = Rotary (Rev) Options: 0 = Rotary (Rev) 1 = Linear (mm)	R/W
35	Fbk 2 Polarity	Defines the direction polarity for encoder 2.	Default: 0 = Same as encoder (Normal) Options: 0 = Same as encoder (Normal) 1 = Reversed	R/W
36	Fbk 2 Resolution	Counts/Revolution.	Default: 0 Range: 0…65,535 pulses/revolution or pulses/mm based on rotary or linear configuration defined by P34 [Fbk 2 Units] parameter	R
37	Fbk 2 Volt Mon	Encoder 2 voltage to be monitored. Not valid when P27 [Fbk Mode] = 0 (1 encoder).	Default: 0 = Voltage not monitored Options: 0 = Voltage not monitored 5 = 5V ±10% 9 = 7…12V 12 = 11…14V 14 = 11.5…15.5V	R/W
38	Fbk 2 Speed	Displays the output speed of encoder 2.	Range: -214,748,364.8…214,748,364.7 rpm or mm/s	R
39	Fbk Speed Ratio	Dual Feedback Speed Ratio. Defines the ratio of the expected speed of encoder 2 divided by the expected speed of encoder 1 Not valid when Fbk Mode = 0 (1 encoder).	Default: 0.0000 Range: 0.0001…10,000.0 ratio based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W
40	Fbk Speed Tol	Dual Feedback Speed Discrepancy Tolerance. Acceptable difference in speed between Fbk 1 Speed and Fbk 2 Speed.	Default: 0 Range: 0…6553.5 rpm or mm/s units are based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W
41	Fbk Pos Tol	Acceptable difference in position between encoder 1 and encoder 2.	Default: 0 Range: 0…65,535 deg or mm units are based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W
42	Direction Mon	Defines the allowable direction if Safe Direction Monitoring is enabled.	Default: 0 = Disabled Options: 0 = Disabled 1 = Positive always (Pos Always) 2 = Negative always (Neg Always) 3 = Positive during safe limited speed monitoring (Pos in SLS) 4 = Negative during safe limited speed monitoring (Neg in SLS)	R/W
43	Direction Tol	The position limit in encoder units tolerated in the wrong direction when Safe Direction Monitoring is active.	Default: 10 Range: 0…65,535 deg or mm based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W

List of Parameters

No.	Name	Description	Values	Read/ Write
44	Safe Stop Input	Configuration for Safe Stop input (SS_In).	Default: 1 = Dual-channel equivalent (2NC) Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)	R/W
45	Safe Stop Type	Safe operating stop type selection. This defines the type of Safe Stop that is performed if the Safe Stop function is initiated by a stop type condition.	Default: 0 = Safe Torque Off with Standstill Checking (Torque Off) Options: 0 = Safe Torque Off with Standstill Checking (Torque Off) 1 = Safe Stop 1 2 = Safe Stop 2 3 = Safe Torque Off without Standstill Checking (Trq Off NoCk)	R/W
46	Stop Mon Delay	Defines the monitoring delay between the request and the Stop Delay [Max Stop Time] when the request for a Safe Stop 1 or a Safe Stop 2 is initiated by an SS_In input ON to OFF transition. If the Safe Stop Type is Safe Torque Off with or without Standstill Speed Checking, the Stop Monitor Delay must be 0 or an Invalid Configuration Fault occurs.	Default: 0 Range: 0…6553.5 s	R/W
47	Max Stop Time	Stop Delay Defines the maximum stop delay time that is used when the Safe Stop function is initiated by a stop type condition.	Default: 0 Range: 0…6553.5 s	R/W
48	Standstill Speed	Defines the speed limit that is used to declare motion as stopped. Not valid for Safe Torque Off without Standstill Checking.	Default: 0.001 Range: 0.001…65.535 rpm or mm/s based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W
49	Standstill Pos	Standstill Position Window. Defines the position limit window in encoder 1 degrees or mm that will be tolerated after a safe stop condition has been detected. Not valid for Safe Torque Off without Standstill Checking.	Default: 10 Range: 0…65,535 degrees (360° = 1 revolution) or mm based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W
50	Decel Ref Speed	Deceleration Reference Speed. Determines deceleration rate to monitor for Safe Stop 1 or Safe Stop 2.	Default: 0 Range: 0…65,535 rpm or mm/s based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W
51	Stop Decel Tol	Decel Tolerance. This is the acceptable tolerance above the deceleration rate set by the P50 [Decel Ref Speed] parameter.	Default: 0 Range: 0…100% of Decel Ref Speed	R/W
52	Lim Speed Input	Configuration for the Safe Limited Speed input (SLS_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)	R/W
53	LimSpd Mon Delay	Defines the Safe Limited Speed Monitoring Delay between the SLS_In ON to OFF transition and the initiation of the Safe Limited Speed (SLS) monitoring.	Default: 0 Range: 0…6553.5 s	R/W
54	Enable SW Input	Configuration for the Enabling Switch input (ESM_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)	R/W

List of Parameters

No.	Name	Description	Values	Read/ Write
55	Safe Speed Limit	Defines the speed limit that will be monitored in Safe Limited Speed (SLS) mode.	Default: 0 Range: 0…6553.5 rpm or mm/s based on rotary or linear configuration defined by P29 [Fbk 1 Units] parameter	R/W
56	Speed Hysteresis	Provides hysteresis for SLS_Out output when Safe Limited Speed monitoring is active.	Default: 0 Range: 0% when P21 [Safety Mode] = 1, 2, 3, 4, 5, 6, 8, or 9 10…100% when P21 [Safety Mode] = 7 or 10	R/W
57	Door Out Type	Door Control Output Type. Defines the lock and unlock state for door control output (DC_Out). When Door Out Type equals power to release, DC_Out is OFF in the lock state and ON in the unlock state. When Door Out Type equals power to lock, DC_Out is ON in the lock state and OFF in the unlock state. The first and middle units of a multi-axis system must be configured as cascading (2).	Default: 0 = Power to release (Pwr to Rel) Options: 0 = Power to release (Pwr to Rel) 1 = Power to lock (Pwr to Lock) 2 = Cascaded (2 Ch Sourcing)	R/W
58	DM Input	Configuration for the Door Monitor input (DM_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)	R/W
59	Lock Mon Enable	Lock Monitoring can only be enabled when the speed monitoring safety relay is a single unit or as the first unit in a multi-axis system (P20 [Cascaded Config] equals 0 or 1).	Default: 0 = Disable Options: 0 = Disable 1 = Enable	R/W
60	Lock Mon Input	Configuration for the Lock Monitor input (LM_In).	Default: 0 = Not used Options: 0 = Not used 1 = Dual-channel equivalent (2NC) 2 = Dual-channel equivalent 3 s (2NC 3s) 3 = Dual-channel complementary (1NC + 1NO) 4 = Dual-channel complementary 3 s (1NC + 1NO 3s) 5 = Dual-channel SS equivalent 3 s (2 OSSD 3s) 6 = Single channel (1NC)	R/W
61	Max Speed Enable	Enable Safe Maximum Speed Monitoring.	Default: 0 = Disable Options: 0 = Disable 1 = Enable	R/W
62	Safe Max Speed	Defines the maximum speed limit that will be tolerated if Safe Maximum Speed monitoring is enabled.	Default: 0 Range: 0…65,535 rpm or mm/s based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W
63	Max Spd Stop Typ	Safe Maximum Speed Monitoring Stop Behavior. Defines the safe stop type that will be initiated in the event of a SMS Speed Fault.	Default: 0 = Use Safe Torque Off with Check for Standstill (Torque Off) Options: 0 = Use Safe Torque Off with Check for Standstill (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)	R/W
64	Max Accel Enable	Enable Safe Maximum Acceleration Monitoring.	Default: 0 = Disable Options: 0 = Disable 1 = Enable	R/W
65	Safe Accel Limit	Defines the Safe Maximum Acceleration Limit, relative to encoder 1, for which the system is being monitored.	Default: 0 Range: 0…65,535 rev/s^2 or mm/s^2 based on rotary or linear configuration defined by the P29 [Fbk 1 Units] parameter	R/W

List of Parameters

No.	Name	Description	Values		Read/ Write
66	Max Acc Stop Typ	Safe Maximum Acceleration Monitoring Stop Behavior. Defines the safe stop type that will be initiated in the event of an Acceleration Fault.	Default: Range:	0 = Use Safe Torque Off with Check for Standstill (Torque Off) 0 = Use Safe Torque Off with Check for Standstill (Torque Off) 1 = Use Configured Safe Stop Type (Safe Stp Typ)	R/W
67	Fault Status	Bit-encoded faults.	Bit 0: Bit 1: Bit 2: Bit 3: Bit 4: Bit 5: Bit 6: Bit 7: Bit 8: Bit 9: Bit 10: Bit 11: Bit 12: Bit 13: Bit 14: Bit 15: Bit 16: Bit 17: Bit 18: Bit 19: Bit 20: Bit 21: Bit 22: Bit 23: Bit 24: Bit 25: Bit 26: Bit 27: Bit 28: Bit 29: Bit 30: Bit 31:	Combined Fault Status (Combined Flt) Reserved for Core Error (Core Error) Invalid Configuration Fault (Invalid Cfg) MP Out Fault (MP Out Flt) Reset On at PwrUp Fault (Reset PwrUp) Feedback 1 Fault (Fbk 1 Flt) Feedback 2 Fault (Fbk 2 Flt) Dual FB Speed Fault (Dual Fbk Spd) Dual FB Position Fault (Dual Fbk Pos) SS_In Fault (SS In Flt) SS_Out Fault (SS Out Flt) Deceleration Fault (Decel Flt) Stop Speed Fault (Stop Spd Flt) Motion After Stopped Fault (Mov in Stop) SLS_In Fault (SLS In Flt) SLS_Out Fault (SLS Out Flt) SLS_Speed Fault (SLS Spd Flt) SMS_Speed Fault (SMS Spd Flt) Acceleration Fault (Accel Flt) Direction Fault (Dir Flt) DM_In Fault (DM In Flt) Door Monitoring Fault (Door Mon Flt) DC_Out Fault (DC Out Flt) LM_In Fault (LM In Flt) Lock Monitoring Fault (Lock Mon Flt) ESM_In Fault (ESM In Flt) ESM Monitoring Fault (ESM Mon Flt) Encoder 1 Voltage Fault (Fbk 1 V Flt) Encoder 2 Voltage Fault (Fbk 2 V Flt) RLM Reset Fault (RL Flt) Reserved Reserved	R

List of Parameters

No.	Name	Description	Values	Read/ Write
68	Guard Status	Bit 0: StatusOK Bit 1: Configuration_Lock (Config Lock) Bit 2: MP_Out_Value (MP Out) Bit 3: SS_In_Value (SS In) Bit 4: SS_Request_Status (SS Req) Bit 5: SS_In_Progress (SS In Prog) Bit 6: SS_Decelerating_Status (SS Decel) Bit 7: SS_Axis_Stopped_Status (SS Stopped) Bit 8: SS_Output_Value (SS Out) Bit 9: SLS_In_Value (SLS In) Bit 10: SLS_Request_Status (SLS Req) Bit 11: SLS_In_Progress (SLS In Prog) Bit 12: SLS_Output_Value (SLS Out) Bit 13: SMS_In_Progress (SMS In Prog Bit 14: SMA_In_Progress (SMA In Prog) Bit 15: SDM_In_Progress (SDM In Prog) Bit 16: DC_Lock_Status (DC Lock) Bit 17: DC_Out_Value (DC Out) Bit 18: DM_In_Value (DM In) Bit 19: DM_In_Progress (DM In Prog) Bit 20: LM_In_Value (LM In) Bit 21: ESM_In_Value (ESM In) Bit 22: ESM_In_Progress (ESM In Prog) Bit 23: Reset_In_Value (Reset In) Bit 24: Waiting_for_SS_Reset (Wait Reset) Bit 25: Waiting_for_Cycle_SS_In (Wait SS Cyc) Bit 26: Waiting_for_Stop_Request_Removal (Wait No Stop) Bit 27: SLS_Comand_Value (SLS Cmd) Bit 28: Stop_Command_Value (Stop Cmd) Bit 29…Bit 31: Reserved	0 = Fault; 1 = OK 0 = Unlock; 1 = Lock 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 1 = Lock; 0 = Unlock 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Inactive; 1 = Active 0 = Off; 1 = On 0 = Off; 1 = On	R

List of Parameters

No.	Name	Description	Values	Read/ Write
69	IO Diag Status	Indicates present state of I/O used for diagnostics. Bit 0: SS_in_ch_0 status (SS In Ch 0) Bit 1: SS_in_ch_1 status (SS In Ch 1) Bit 2: SS_out_ch_0 status (SS Out Ch 0) Bit 3: SS_out_ch_1 status (SS Out Ch 1) Bit 4: SLS_in_ch_0 status (SLS In Ch 0) Bit 5: SLS_in_ch_1 status (SLS In Ch 1) Bit 6: SLS_out_ch_0 status (SLS Out Ch 0) Bit 7: SLS_out_ch_1 status (SLS Out Ch 1) Bit 8: ESM_in_ch_0 status (ESM In Ch 0) Bit 9: ESM_in_ch_1 status (ESM In Ch 1) Bit 10: DM_in_ch_0 status (DM In Ch 0) Bit 11: DM_in_ch_1 status (DM In Ch 1) Bit 12: DC_out_ch_0 status (DC Out Ch 0) Bit 13: DC_out_ch_1 status (DC Out Ch 1) Bit 14: LM_in_ch_0 status (LM In Ch 0) Bit 15: LM_in_ch_1 status (LM In Ch 1) Bit 16: Reset_In status (Reset In) Bit 17: RL_In status (RL In) Bit 18: SLS_command status (SLS Cmd) Bit 19: Stop_command status (Stop Cmd) Bit 20: MP_Out_Ch_0 status (MP Out Ch 0) Bit 21: MP_Out_Ch_1 status (MP Out Ch 1) Bit 22: Reserved (0) Bit 23: Reserved (0) Bit 24: Reserved (0) Bit 25: Reserved (0) Bit 26: Reserved (0) Bit 27: Reserved (0) Bit 28: Reserved (0) Bit 29: Reserved (0) Bit 30: Reserved (0) Bit 31: Reserved (0)	0 = Open; 1 = Closed **IMPORTANT:** When the MSR57P relay is not in the Run mode, the P69 [IO Diag Status] parameter is not updated.	R

List of Parameters

No.	Name	Description	Values	Read/ Write
70	Config Flt Code	Configuration Fault Code.	Options: 0 = No Fault 1 = Password Required (Password Req) 2 = P21 [Safety Mode] value not legal based on P20 [Cascaded Config] value. 3 = P57 [Door Out Type] value not legal based on P20 [Cascaded Config] value. 4 = P46 [Stop Mon Delay] value not legal based on P45 [Safe Stop Type] value. 5 = P50 [Decel Ref Speed] value not legal based on P31 [Fbk 1 Resolution] value. 6 = P48 [Standstill Speed] value not legal based on P20 [Cascaded Config] value. 7 = P53 [LimSpd Mon Delay] value not legal based on P21 [Safety Mode] value. 8 = P55 [Safe Speed Limit] value not legal based on P21 [Safety Mode] and P31 [Fbk 1 Resolution] value. 9 = P56 [Speed Hysteresis] value not legal based on P21 [Safety Mode] value. 10 = P62 [Safe Max Speed] value not legal based on P31 [Fbk 1 Resolution] value. 11 = P42 [Direction Mon] value not legal based on P21 [Safety Mode] value. 12 = P59 [Lock Mon Enable] value not legal based on P21 [Safety Mode] value. 13 = P36 [Fbk 2 Resolution] value not legal based on P27 [Fbk Mode] value. 14 = P35 [Fbk 2 Polarity] value not legal based on P27 [Fbk Mode] value. 15 = P39 [Fbk Speed Ratio] value not legal based on P27 [Fbk Mode] value. 16 = P41 [Fbk Pos Tol] value not legal based on P27 [Fbk Mode] value. 17 = P40 [Fbk Speed Tol] value not legal based on P27 [Fbk Mode] value. 18 = P44 [Safe Stop In Typ] value not legal based on P21 [Safety Mode] value. 19 = P52 [Lim Speed Input] value not legal based on P21 [Safety Mode] value. 20 = P58 [DM Input Type] value not legal based on P20 [Cascaded Config] and P21 [Safety Mode] value. 21 = P54 [Enable SW In Typ] value not legal based onP21 [Safety Mode] value. 22 = P60 [Lock Mon In Type] value not legal based on P21 [Safety Mode] value and P59 [Lock Mon Enable] value. 23 = Illegal P20 [Cascaded Config] value. 24 = Illegal P22 [Reset Type] value. 25 = Illegal P23 [Reset Loop] value. 26 = Illegal P45 [Safe Stop Type] value. 27 = Illegal P51 [Stop Decel Tol] value. 28 = Illegal P27 [Fbk Mode] value. 29 = Illegal P28 [Fbk 1 Type] value. 30 = Illegal P31 [Fbk 1 Resolution] value. 31 = Illegal P32 [Fbk1 Volt Mon] value. 32 = Illegal P37 [Fbk 2 Volt Mon] value. 33 = Illegal P24 [OverSpd Response] value. 34 = Illegal P71 [MP Out Mode] value. 35 = Unknown error (Unknown Err).	R

List of Parameters

No.	Name	Description	Values	Read/ Write
71	MP Out Mode	Defines whether the MP_Out output is pulse-tested.(1)	Default: 0 = Pulse Test	R/W
			Options: 0 = Pulse test 1 = No pulse test	
72	SS Out Mode	Defines whether the SS_Out output is pulse-tested.(1)	Default: 0 = Pulse Test	R/W
			Options: 0 = Pulse test 1 = No pulse test	
73	SLS Out Mode	Defines whether the SLS_Out output is pulse-tested.(1)	Default: 0 = Pulse Test	R/W
			Options: 0 = Pulse test 1 = No pulse test	
74	Door Out Mode	Defines whether the DC_Out output is pulse-tested.(1)	Default: 0 = Pulse Test	R/W
			Options: 0 = Pulse test 1 = No pulse test	

(1) If pulse-testing is turned off for any output, the SIL, Category, and PL rating is reduced for the entire MSR57P safety system.

Using a HIM

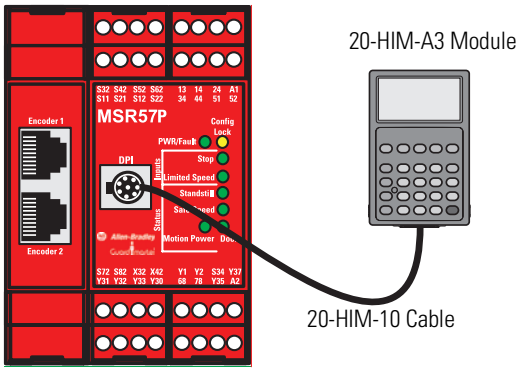
Introduction

Topic	Page
Connect a HIM Module	213
Setting Parameters with a HIM Module	214
Accessing the Fault History Queue	215

Connect a HIM Module

You can set the MSR57P parameters by using a HIM module or a personal computer running DriveExplorer or DriveExecutive software.

Connect the 20-HIM-A3 module to the relay by using a 20-HIM-H10 cable.



Setting Parameters with a HIM Module

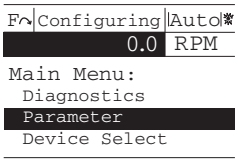
A HIM module displays only one parameter at a time. The keypad lets you scroll through the HIM menu structure to find the parameters you need to set.

Once the HIM module is connected to the safety relay, follow these steps to set parameters.

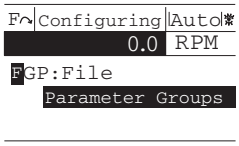
1. If necessary, configure the HIM module to display parameters by logical groups.

   a. Press ALT + Sel.

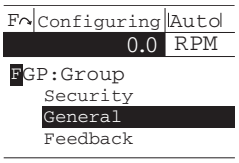
   b. Press ▲ or ▼ to select File - Group - Par from the Param Dspy Item menu and press ↵.



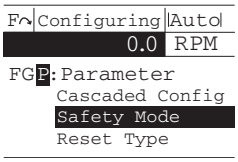
2. In the Main Menu, press ▲ or ▼ to scroll to Parameter and press ↵.



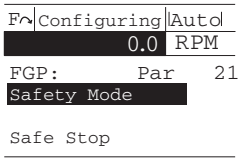
3. Press ↵ to choose the Parameter file and display the groups in that file.



4. Scroll to the desired group and press ↵ to display the parameters in that group.



5. Scroll to the desired parameter and press Enter to display the parameter value screen.



6. Press Enter to edit the parameter.
7. Press Up or Down to change the value.
8. If desired, press Sel to move from digit to digit, letter to letter, or bit to bit.

   Digits or bits that you can change are highlighted.
9. Press Enter to save the value or Esc to cancel the change.
10. Press Esc to return to the group list.

TIP Numeric Keypad Shortcut

You can also press ALT + +/– to access a parameter by typing its number.

ATTENTION

The red stop button on the HIM keypad does not have safety integrity. Do not use the stop button to execute a safe stop.

TIP If the red stop button on the HIM keypad is pressed, you must press the green button on the HIM keypad to reset the MSR57P.

Accessing the Fault History Queue

To view the contents of the fault history queue, choose Diagnostics>Faults>View Fault Queue from the top-level menu.

Use DriveExplorer or DriveExecutive Software

Introduction

Topic	Page
Connect a Personal Computer	217
Using DriveExplorer Software	218
Using DriveExecutive Software	221

Connect a Personal Computer

You must have either DriveExplorer or DriveExecutive software installed on your personal computer and an serial or USB converter.

Description	Catalog Number	Version
DriveExplorer software	9306-4EXP02ENE	5.02 or later
DriveExecutive software	9303-4DTE01ENE	4.01 or later
RSLinx (1) software	9355 series	2.50.00 or later
Serial Converter (2)	1203-SSS (series B)	3.004 or later
Universal Serial Bus Converter(3)	1203-USB	1.001 or later

(1) RSLinx software is required by DriveExecutive software, but it is not required by DriveExplorer software.

(2) The serial converter, catalog number 1203-SSS (series B), contains: 1203-SFC cable from personal computer serial to the converter, 1202-C10 cable from the converter to DPI port, and a serial converter body.

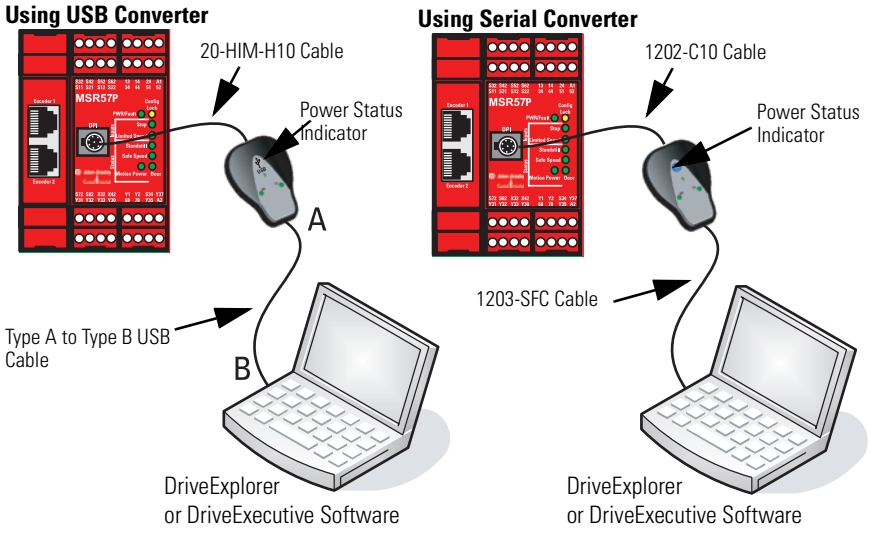
(3) Catalog number 1203-USB contains the converter body, a 20-HIM-H10 cable to connect to the DPI port, and a type A to type B USB cable to connect the 1203-USB converter to a personal computer.

A free version of DriveExplorer Lite software is available for download at http://www.ab.com/drives/driveexplorer/free_download.html.

Follow these steps to connect the personal computer to the DPI port on the front of the relay.

1. Connect the appropriate cable between the COM port on your personal computer and the communication port on the serial or USB converter.

2. Connect the appropriate cable between the serial or USB converter and the DPI connector on the relay.



3. Observe the status indicator to verify that the serial or USB converter has power.

4. Configure communication following the steps in Using DriveExplorer Software on page 218 or Using DriveExecutive Software on page 221.

Using DriveExplorer Software

You need to configure communication between DriveExplorer software and the DPI port on the relay before you can use the software to edit the relay's parameters.

Configure Serial Communication

Follow these steps to configure communication between DriveExplorer software on your personal computer, the serial or USB communication converter, and the DPI port on the relay.

If you are using the 1203-USB converter, you must install the USB drivers on your personal computer. The drivers are provided on the DriveExplorer Lite CD supplied with the converter.

For information on installing drivers, refer to the USB Converter User Manual, publication DRIVES-UM001.

1. Launch DriveExplorer software.

2. From the Explore menu, choose Connect and Configure Communication.

3. On the Configure Communication dialog, choose the serial port to which you are connected and type the baud rate.

   If you are using the USB converter, the communication port must match the port that was mapped when you installed the USB drivers and the communication rate must be set to 115,200 bps.

When communication is established, DriveExplorer software maps your relay.

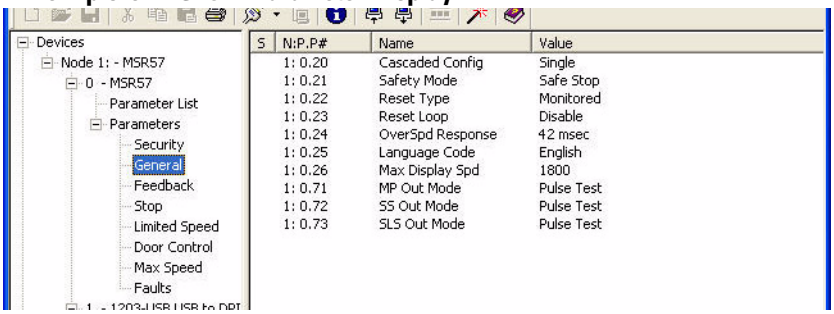
Successful uploading of your relay parameters results in an MSR57P relay parameter display.

Edit Parameters in DriveExplorer Software

In DriveExplorer software, you can choose parameters from the linear list or by using the file and group.

The left pane of the DriveExplorer software interface shows the connected devices and the right pane lists the parameters available.

DriveExplorer MSR57P Parameter Display



DriveExplorer Software Parameter Information

Column	Description of Contents	
S	Status R = * =	 Read only Editable
N:P,P#	N = P = P# =	The node number of the device on the network The port number (0 if a device) The parameter number associated with a specific programming parameter
Name	The item name	
Value	The present value of the item	
Units	The unit of measurement for the item	

Follow these steps to edit a parameter.

1. Expand the MSR57P relay.
2. Choose either Parameter List or expand the Parameter file to display the parameter groups.

TIP The configuration can only be edited when the MSR57P relay is unlocked and in Program mode.

3. You can edit a parameter by double-clicking it and entering the new value.
4. Follow the procedure in Configure the Speed Monitoring Relay on page 158 to configure the MSR57P relay.

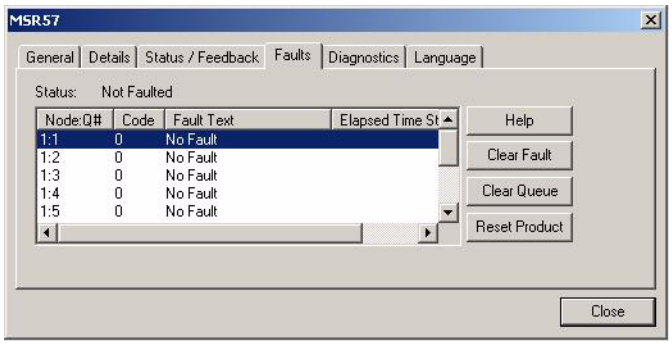
After you edit parameters, you can upload them and save them to a file on you personal computer. The file can be used as a backup, printed, or downloaded to another MSR57P relay.

For detailed information on using DriveExplorer software, consult online help.

Access the Fault History Queue

Follow these steps to view the contents of the fault history queue.

1. From the DriveExplorer menu, choose Explore>Device Properties.
2. Click the Faults tab on the device dialog.



Using DriveExecutive Software

You need to configure communication between DriveExecutive software and the DPI port on the relay before you can use the software to edit the relay's parameters.

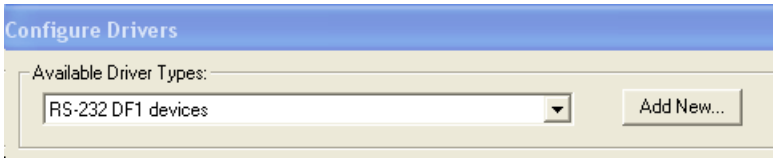
Configure Serial Communication

Follow these steps to configure communication between DriveExecutive software on your personal computer, the AnaCANda or USB communication converter, and the DPI port on the relay.

1. Open RSLinx software.

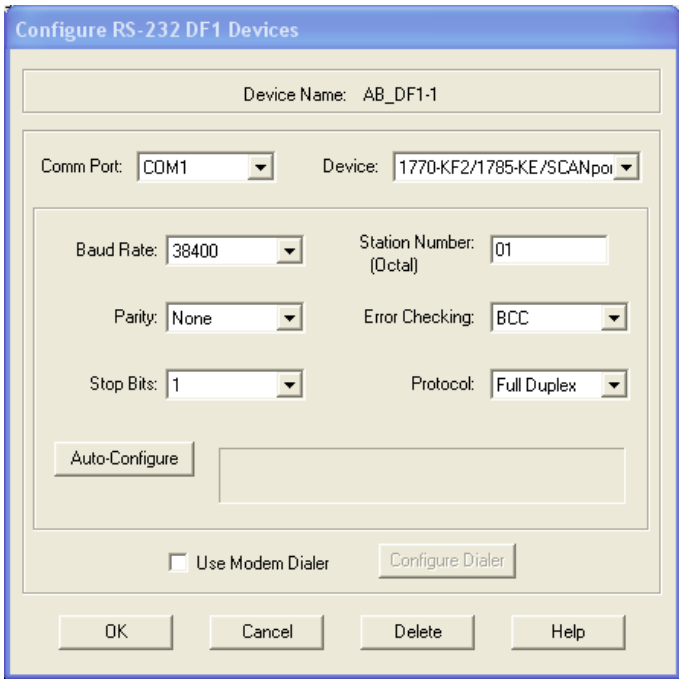
IMPORTANT DriveExecutive software must exchange information via RSLinx software. This requires serial communication between the DPI port on the relay and your personal computer. The Ethernet network, or other communication standards are not compatible.

2. In RSLinx software, configure a communication driver to interface between your personal computer and the DPI port on the relay.
   a. Click Add New.



   b. From the Available Driver Types pull-down menu, choose RS-232 DF1.
   c. Click OK.

3. Configure the RS232 DF1 device as shown.



a. Choose the Comm Port to which you are connected.

   If you are using the USB converter, the comm port must be the port that was mapped when you installed the USB drivers.

b. Choose the correct baud rate for the relay.

   If you are using the USB converter the correct communication rate is 115,200 bps.

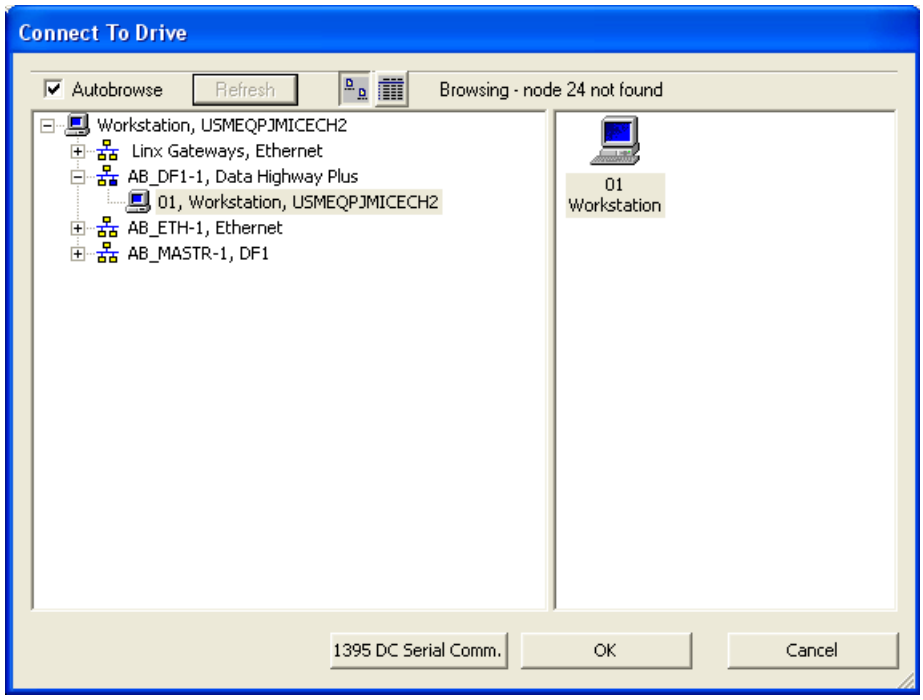
c. Close any conflicting programs that might be using this port at this time.

d. From the Device pull-down menu, choose the SCANport device.

e. In the Station Number box, type 01.

5. Click OK.

6. Open RSWho in RSLinx software to verify that the new driver is recognized.



7. Close RSLinx software.

8. Open DriveExecutive software.

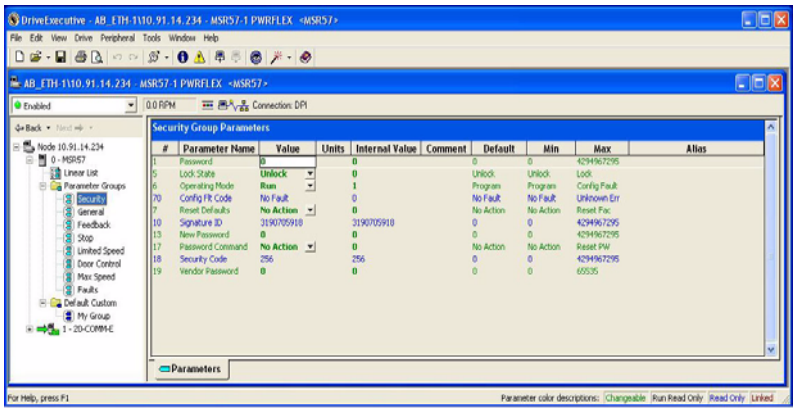
9. Advance to Drive Selection and choose Connect to Drive.

10. Choose your workstation (01 in the preceding diagram) and click OK.

    DriveExecutive software connects with the relay and begins to upload its parameters. A parameter upload initially occurs, followed by a file group upload. Each upload displays in a separate dialog.

Edit Parameters

In DriveExecutive software, you can choose parameters from the linear list or by using the file and group.


DriveExecutive - AB_ETH-1\10.91.14.234 - MSR57.1 PWRFLEX <MSR57>
File Edit View Drive Peripheral Tools Window Help
AB_ETH-1\10.91.14.234 - MSR57.1 PWRFLEX <MSR57>
Enabled
0.0 RPM
Connection: DPI
Security Group Parameters
Parameter Name Value Units Internal Value Comment Default Min Max Alias
1 Password 0 0 0 0 4294967295
5 Lock State Unlock 0 Unlock Unlock Lock
6 Operating Mode Run 1 Program Program Config Fault
70 Config FR Code No Fault 0 No Fault No Fault Unknown Err
7 Reset Defaults No Action 0 No Action No Action Reset Fac
10 Signature ID 3190705918 3190705918 0 0 4294967295
13 New Password 0 0 0 0 4294967295
17 Password Command No Action 0 No Action No Action Reset PW
18 Security Code 256 256 0 0 4294967295
19 Vendor Password 0 0 0 0 65535
Node 10.91.14.234
0 - MSR57
Linear List
Parameter Groups
Security
General
Feedback
Stop
Limited Speed
Door Control
Max Speed
Faults
Default Custom
My Group
1 - 20-COMM-E
Parameters
For Help, press F1
Parameter color descriptions: Changeable Run Read Only Read Only Linked

The left pane of the DriveExecutive software dialog shows the connected devices and the right pane lists the parameters available.

DriveExecutive Parameter Information

Column	Description of Contents
#	Parameter number.
Parameter Name	Short name of the parameter.
Value	Current value of the parameter.
Units	Units of measurement for this parameter.
Internal Value	Internal values are unscaled values used by the device and by controllers that communicate with the device. The information in this field provides the scaling information to calculate the internal value from a scaled value.
Comment	Displays comments previously entered.
Default	Displays the default setting.
Min	The minimum value is the lowest possible value for this parameter.
Max	The maximum value is the highest possible value for this parameter.
Alias	Displays an alias, or alternative name, previously entered.

Follow these steps to edit a parameter.

1. Expand the MSR57P relay.
2. Choose either Parameter List or expand the Parameter file under the MSR57P relay to display the parameter groups.
3. Edit a parameter by double-clicking it and typing the new value.
4. Follow the procedure in Configure the Speed Monitoring Relay on page 158 to configure the MSR57P relay.

After you edit parameters, you can upload them and save them to a file on you personal computer. You can then use this file as a backup, print it, or download it to another MSR57P relay.

For detailed information on using DriveExecutive software, consult online help.

Application Examples

Introduction

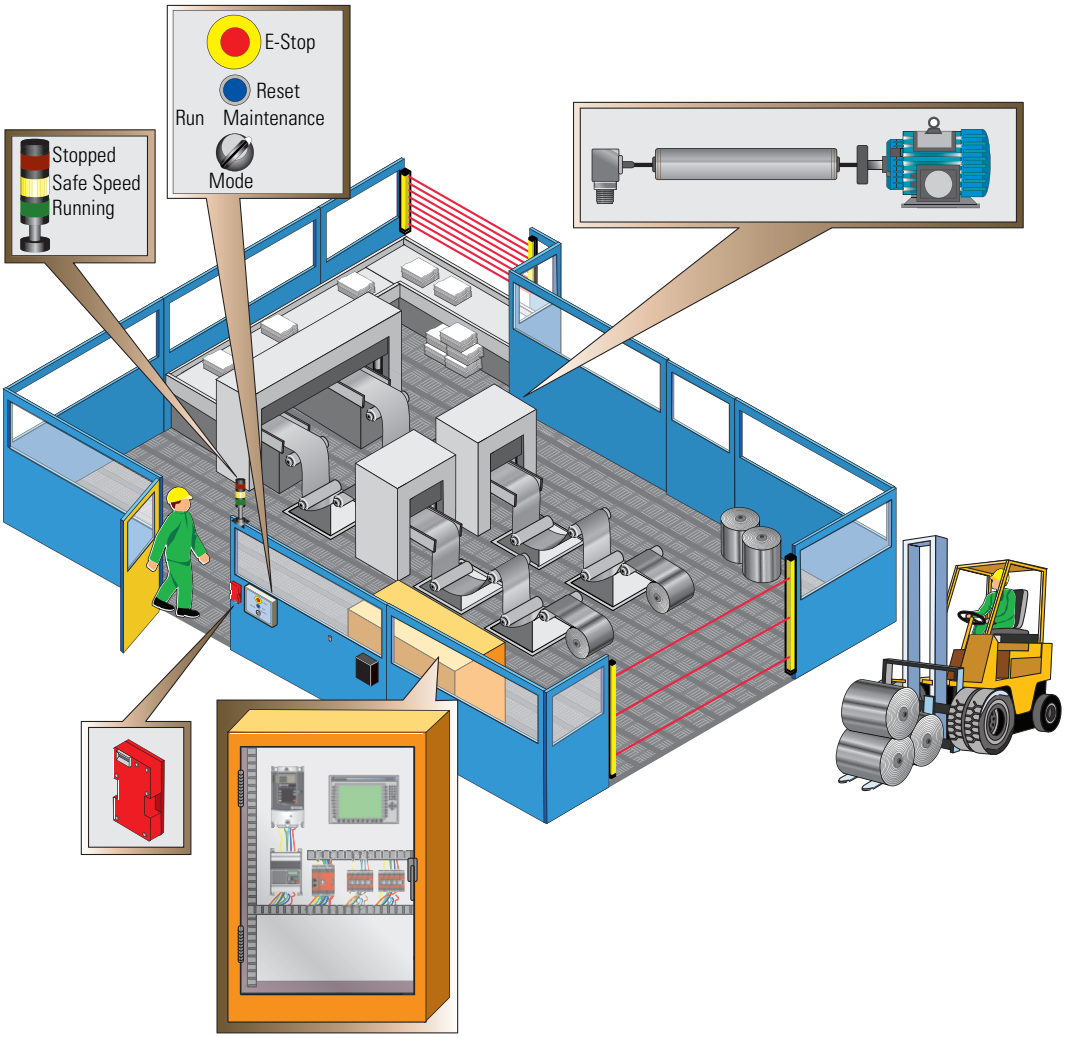
Topic	Page
PowerFlex 70 Drive with Safe-Off Application Example	228
PowerFlex 700 Drive without Safe-Off	231
Kinetix 6000 or Kinetix 7000 Drives with Safe-off Example	233
Kinetix 2000 Drive without Safe-off Example	235

This application appendix provides examples of relay and drive combinations. Refer to the manuals listed in the Additional Resources on page 11 for important information on installing, grounding, wiring, and operating the devices shown in the appendix.

ATTENTION

Implementation of safety circuits and risk assessment is the responsibility of the machine builder.

PowerFlex 70 Drive with Safe-Off Application Example

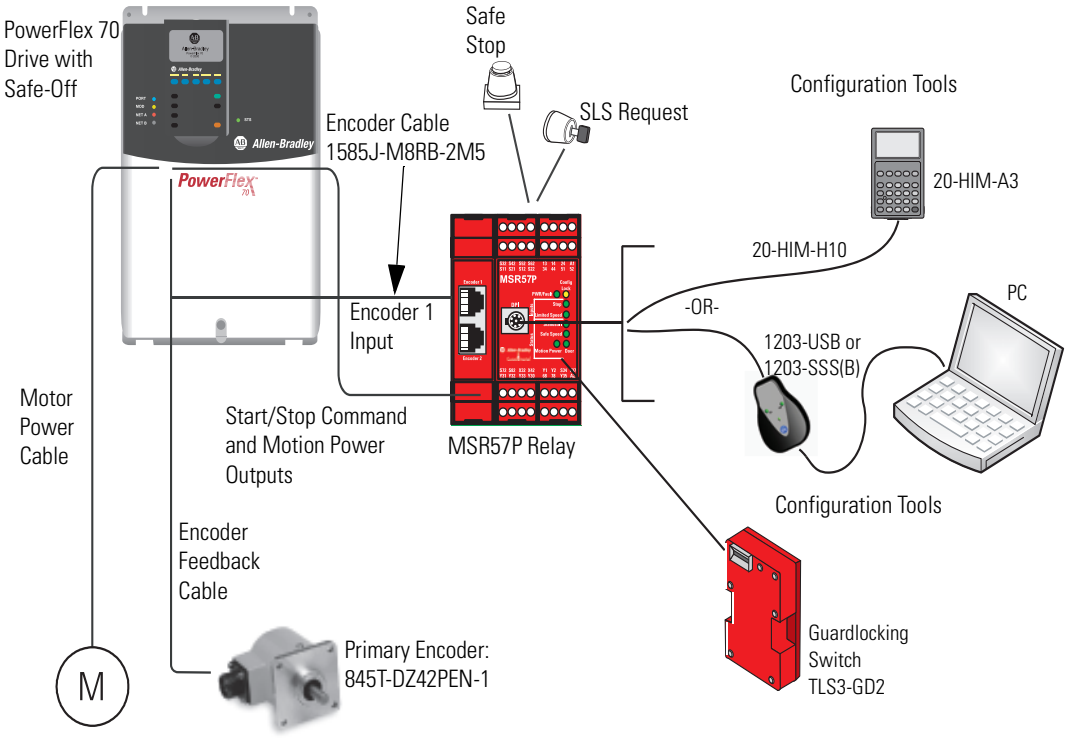


This example is configured for Safe Stop 1. The control cabinet contains an MSR57P relay, a PowerFlex 70 AC Drive with Safe-Off function, as well as a PanelView terminal. The MSR57P relay monitors speed via an incremental encoder connected to the PowerFlex 70 drive.

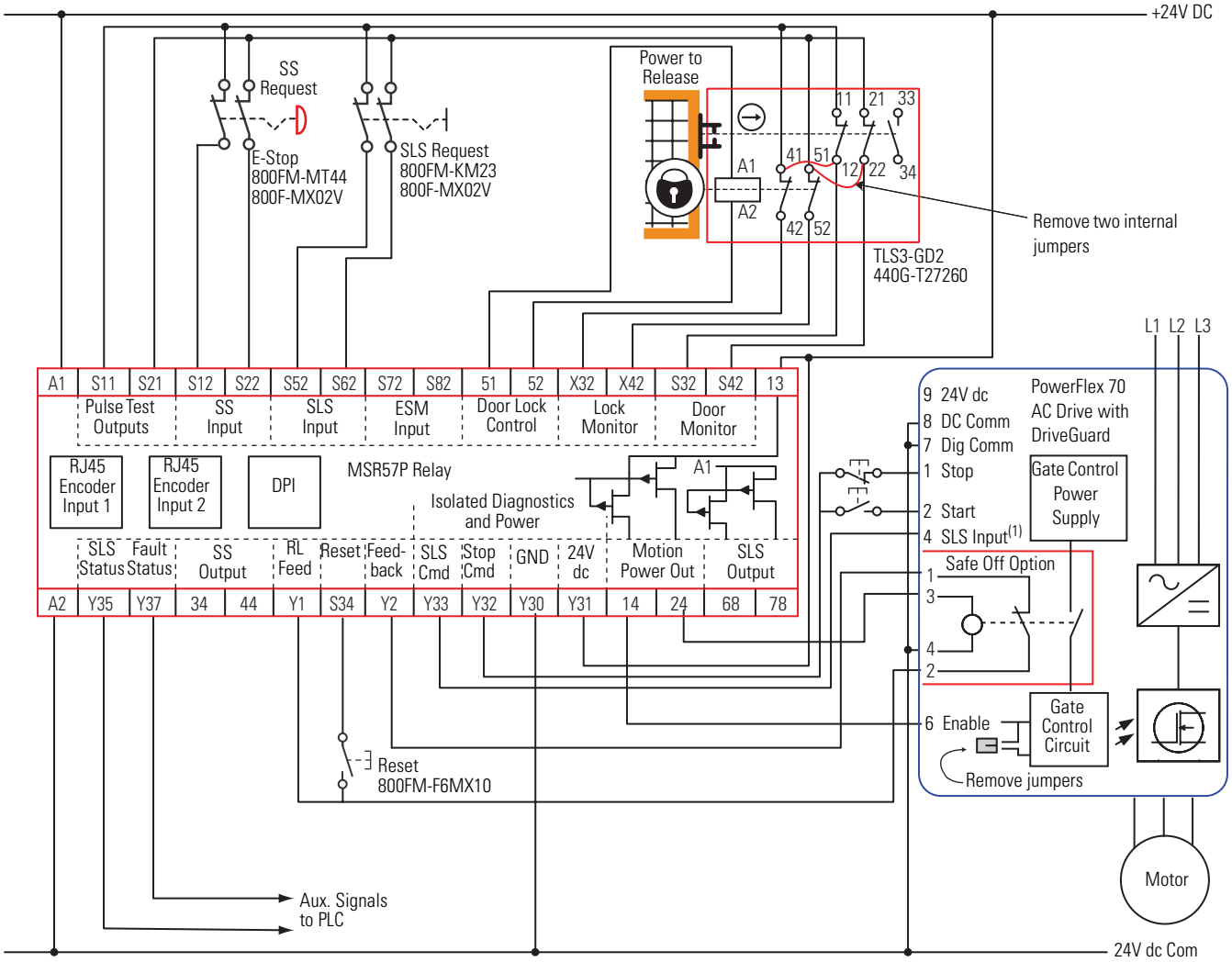
The control panel lets the operator select Run or Maintenance speeds. The door has an interlock switch with guardlocking to limit access to the machine when the machine is operating at normal Run speed.

A towerlight indicates machine status.

PowerFlex 70 Drive System Layout



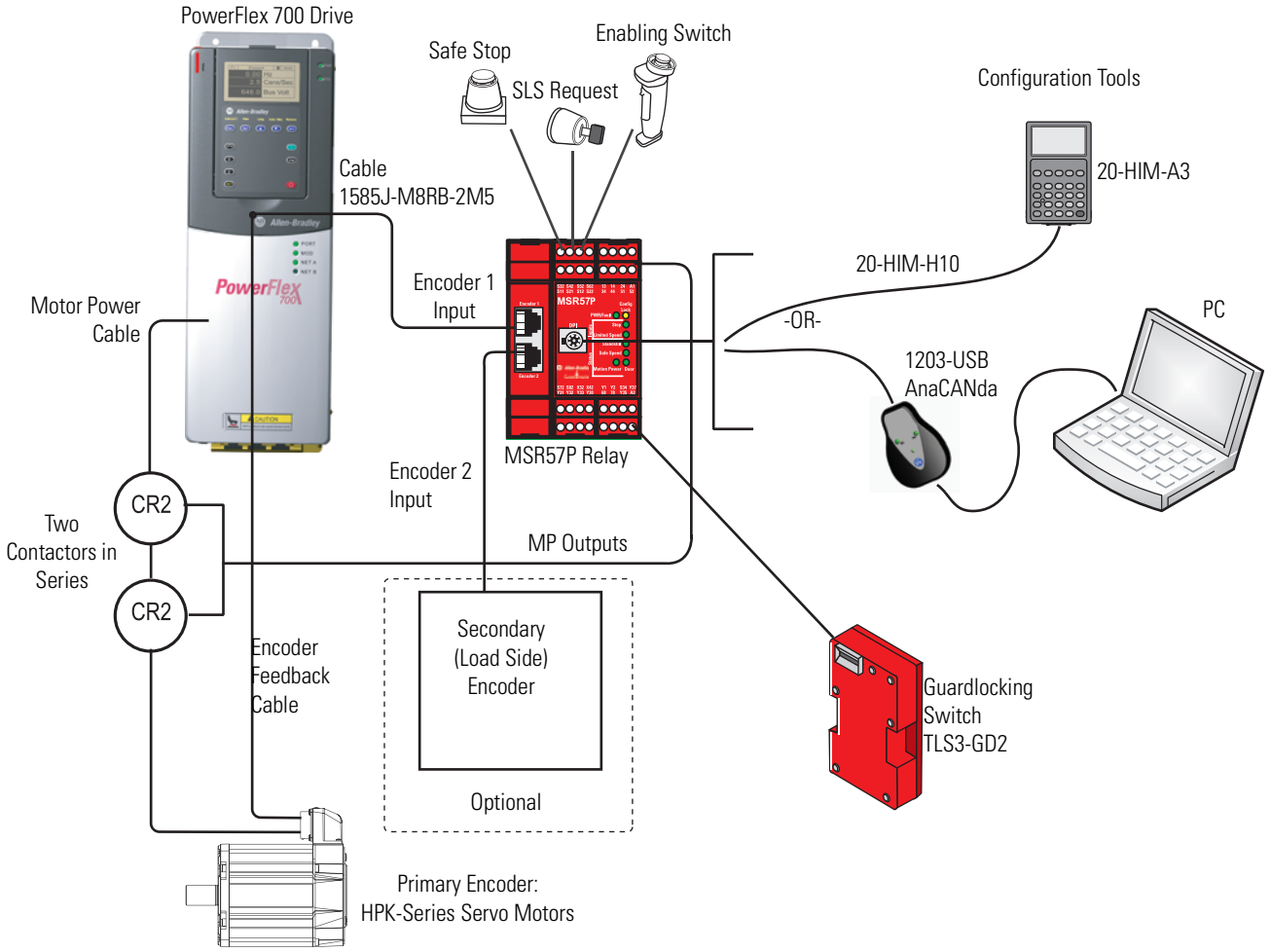
PowerFlex 70 Drive Example Wiring Diagram



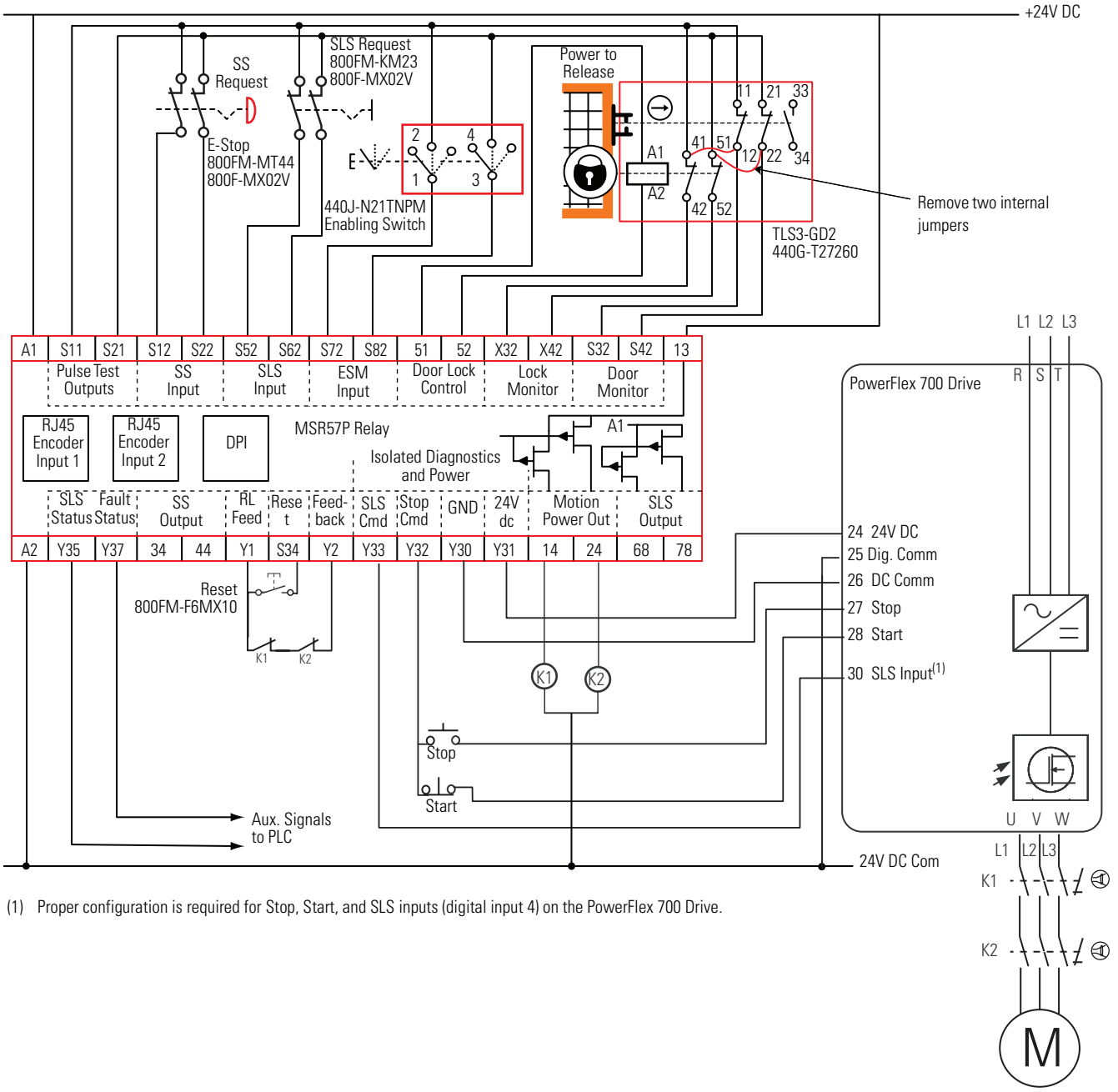
(1) Digital input 4.
Proper configuration is required for inputs 1, 2, 4, and 6 on the PowerFlex 70 Drive.

PowerFlex 700 Drive without Safe-Off

PowerFlex 700 Drive System Layout

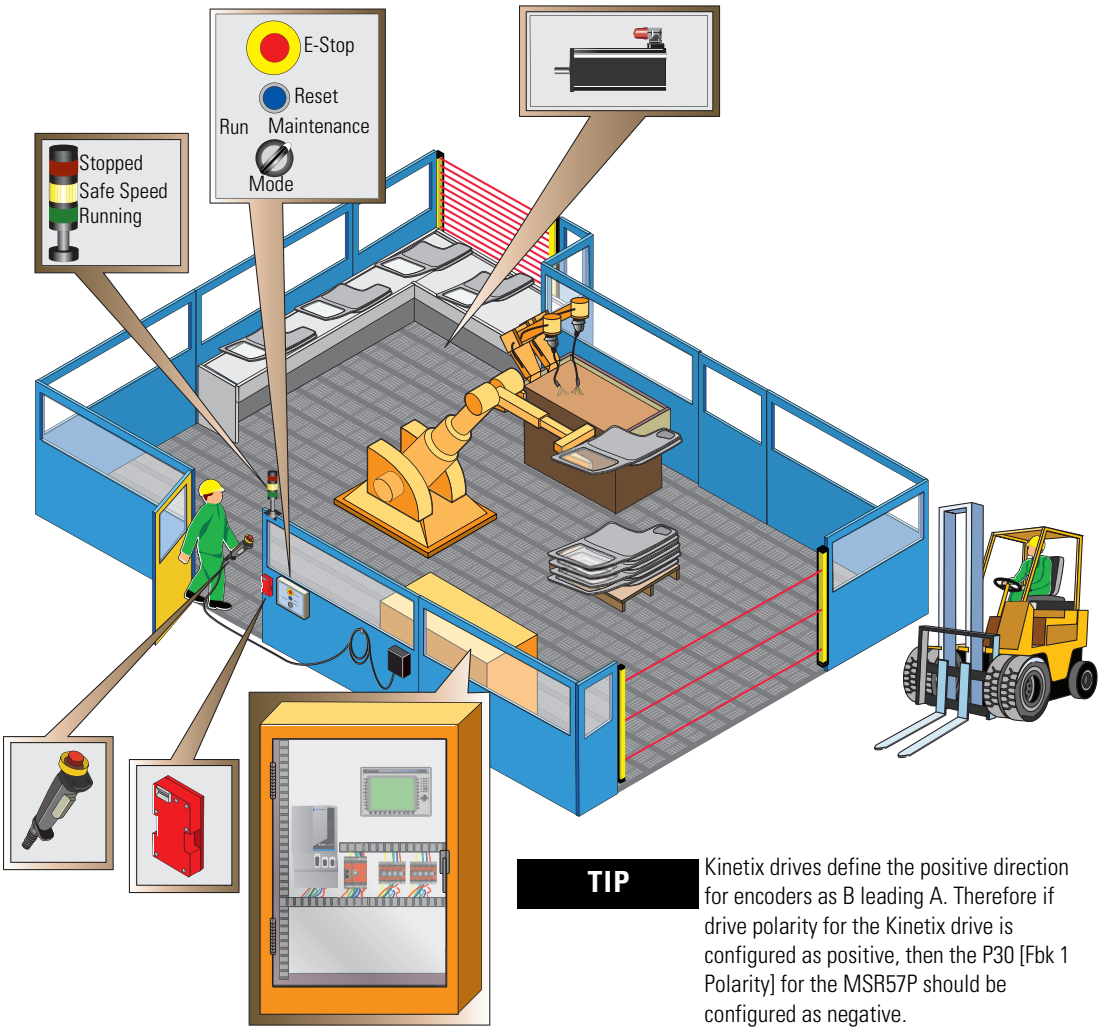


PowerFlex 700 Drive Wiring Diagram



(1) Proper configuration is required for Stop, Start, and SLS inputs (digital input 4) on the PowerFlex 700 Drive.

Kinetix 6000 or Kinetix 7000 Drives with Safe-off Example



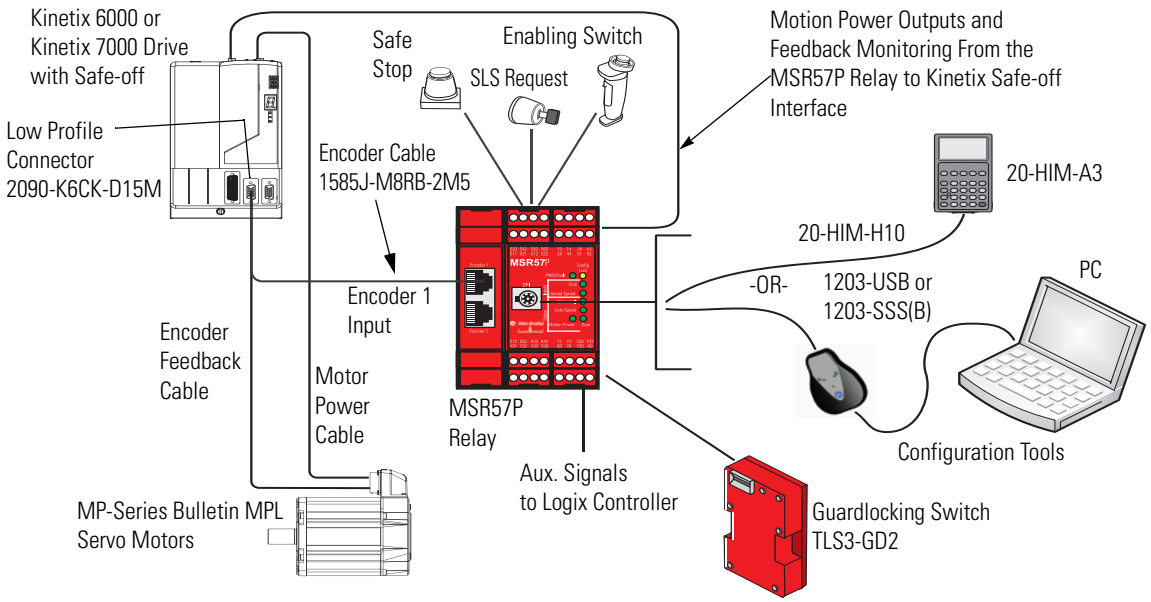
TIP Kinetix drives define the positive direction for encoders as B leading A. Therefore if drive polarity for the Kinetix drive is configured as positive, then the P30 [Fbk 1 Polarity] for the MSR57P should be configured as negative.

This example is configured for Safe Stop 1. The control cabinet contains an MSR57P relay, a Kinetix 6000 drive with Safe-off function, as well as a PanelView terminal. The MSR57P relay monitors speed via a Sin/Cos encoder connected to the Kinetix 6000 drive.

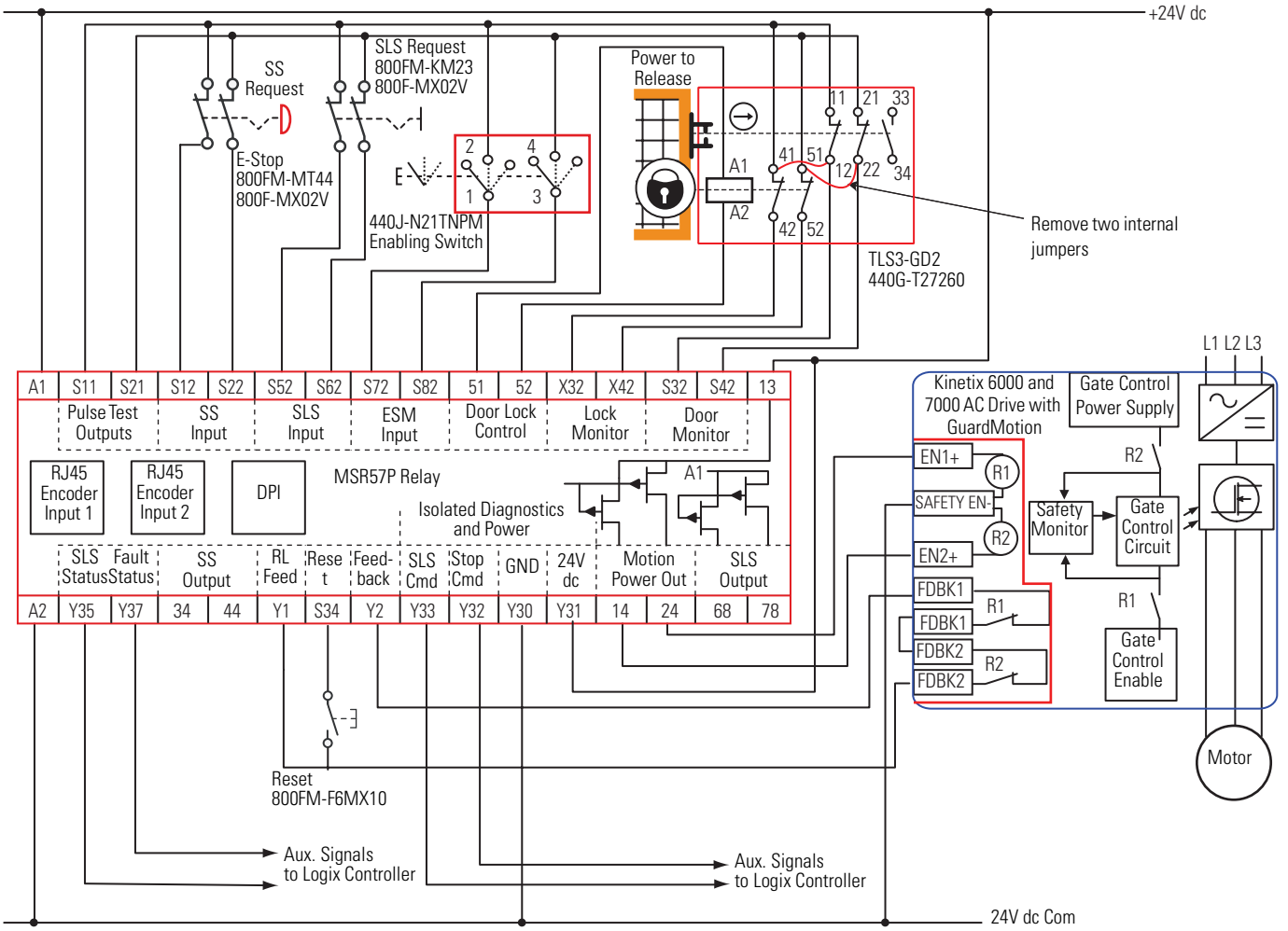
The control panel lets the operator select Run or Maintenance speeds. The door has an interlock switch with guardlocking to limit access to the machine when the machine is operating at normal Run speed. In addition, an enabling switch is required to be held in the middle position while operators are within the machine environment to keep the machine running at safe speed.

A towerlight indicates machine status.

Kinetix 6000 or Kinetix 7000 Drive System Layout

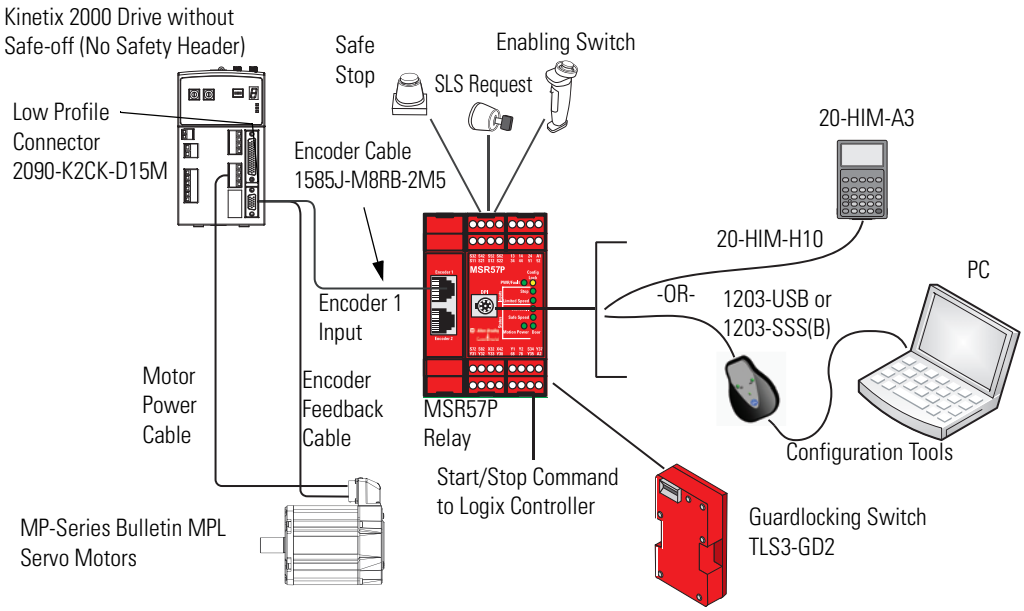


Kinetix 6000 or Kinetix 7000 Drive Wiring Example

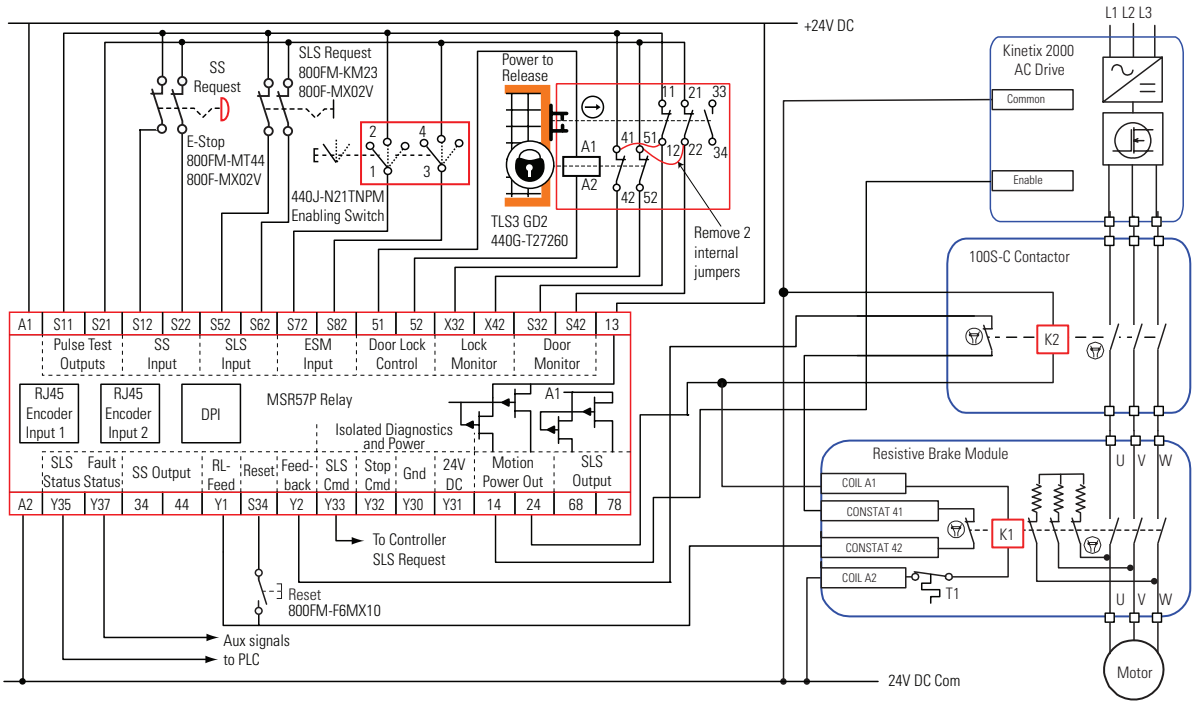


Kinetix 2000 Drive without Safe-off Example

Kinetix 2000 Drive System Layout



Kinetix 2000 Drive Wiring Diagram



Proper configuration in RSLogix 5000 software is required. To enable safety functions, choose Drive Enable Input Checking on the Drive/Motor tab in the Axis Properties dialog of the drive.

For more information, refer to the Kinetix 2000 Multi-axis Servo Drive User Manual, publication 2093-UM001.

Symbols

(PL)e 16

Numerics

1203-SSS 217
1203-USB 217
1203-USB converter
configure communication 218
1585J-M8RB-2M5 cable 42
2 Channel Sourcing 97
20-HIM-A3 module 27, 213
20-HIM-H10 cable 213

A

access
hazardous area 116
automatic reset 74
SLS Reset 107
SS reset 96

C

cable
pinout 42
cascaded config 73, 125, 138
cascaded connections 64, 65, 68
CAT 4 13
Cat 4 9
performance definition 15
certifications 199
clearance 32
commission the system 156-159
commutation 21
Config Lock indicator 154, 159
configuration
lock 153
signature. See Signature ID.
specification 157
Configuration Lock bit 154, 159
configure
parameters 158
confirm the configuration 159
connect
feedback cable 42
HIM module 213
personal computer 217

D

DC_Out output 66
wiring 67, 68
deceleration monitoring 91, 94, 95
dimensions 31
DIN rail 32
Disabled mode 24
discrepancy checking
encoders 82
DM_In input 60
Door Control 97-98
multi-axis systems 138-139
wiring 67
Door Control output
fault conditions 98
See also DC_Out output
Door Monitoring Fault 118
DPI port 213, 217, 218, 221
DriveExecutive software
catalog number 217
configure communication 221
connect to 217
interface 224
set parameters 224
version 27, 217
DriveExplorer software
catalog number 217
configure communication 219
connect to 217
interface 219
set parameters 219
version 27, 217
dual channel operation 57
dual encoder
configurations 82
resolution 82
dual feedback position discrepancy tolerance
definition 83
dual feedback speed discrepancy tolerance
definition 84
dual feedback speed ratio
definition 83

E

edit the configuration 158, 160
emergency shutdown systems 13
EN 60204-1 15
EN 62061 13, 16, 197, 199
enclosure 31

encoder
connecting 36-40
resolution 75
specifications 199
ESM_In input 61, 113
European norm.
definition 9

F

failure
contact information 22
fault
Door Monitoring 118
fault codes
configuration faults 196
Fault While Stopping Faults 189
Safe State Faults 188
Stop Category Faults 189
fault history queue 187
DriveExplorer software 220
HIM 215
fault recovery 187
Fault While Stopping Faults 189, 191
Fault_Status output 70
features 26
feedback
device types 81
fault 86
parameters 86
polarity 82
resolution 81
type 81
feedback monitoring 81-87

G

Guard Status attributes 192

H

HIM module
catalog number 27
set parameters 214
hold last state
SLS_Out output 121

I

I/O Diagnostic Status attributes 195
IEC 61508 13, 16, 197, 199
inputs 57
ISO 13849-1 13, 15, 16, 197, 199

K

keypad 215

L

language
display options 79
LED Indicators 185
LM_In input 61
Lock Monitoring 25, 99
wiring 67
lock status 153
low profile connector kits
wiring 51
low threshold 120, 121
See also Speed Hysteresis.

M

manual monitored reset 74
SLS Reset 107
SS Reset 96
manual reset 74
SLS Reset 107
SS Reset 96
Max Display Speed 80
Max Stop Time
definition 89
motors
feedback pin-outs 44
mounting 32
MP_Out output 69
wiring 69, 70
multi-axis
configuration 137-139
connections ??-126, 138, 139
Door Control 138-139
wiring 64, 65

O

outputs 63
OverSpd Response 75

P

parameter list
all parameters 202-210
feedback 86
general 80
Max Speed and Direction Monitoring 151
Safe Limited Speed 108

Safe Limited Speed Status Only 121
Safe Stop 99
Safe Stop with Door Monitoring 103
Slave, Safe Limited Speed 132
Slave, Safe Limited Speed Status Only 135
Slave, Safe Stop 127
SLS with Door Monitoring 111
SLS with Door Monitoring and Enabling Switch Monitoring 118
SLS with Enabling Switch Monitoring 114
parameters
complete list 202
configure 158
edit 158, 160
groups 201
password
change 154
new 154
reset 155
PFD
definition 10, 16
PFH
definition 10, 16
pin-outs
motor feedback connector 44
PL
definition 10
PL(e) 9, 13, 199
polarity 82
power supply 32
Power to Lock 97
Power to Release 97
probability of failure on demand
See PFD.
probability of failure per hour
See PFH.
proof tests 16
pulse test outputs 57

R

recover from fault 187
remove terminal blocks 32
reset
device configuration 155
password 155
qualification 75
See also SS Reset, SLS Reset, or Reset Type.
reset input 62
wiring 62
Reset Loop input
wiring 63
reset qualification 75
reset type 74
Reset_In input 107
risk assessment 29, 157
RSLinx software 217, 221
version 27

S

Safe Accel Limit
See Safe Maximum Acceleration Limit.
Safe Direction Monitoring 150
negative 151
overview 25
positive 151
Safe Limited Speed mode 105
Safe Limited Speed Monitoring Delay 106, 117, 120
Safe Limited Speed Reset
See SLS Reset.
Safe Limited Speed Status Only mode 119
Safe Limited Speed with Door Monitoring and Enabling Switch Monitoring mode 115
Safe Limited Speed with Door Monitoring mode 110
Safe Limited Speed with Enabling Switch Monitoring mode 112
Safe Max Acceleration Monitoring
overview 25
Safe Max Speed 145
Safe Maximum Acceleration Limit 148
Safe Maximum Acceleration Monitoring
overview 25
Safe Maximum Acceleration monitoring 148-150
Safe Maximum Speed Monitoring
overview 25
Safe Maximum Speed monitoring 145-147
Safe Speed Limit 105, 117, 121
Safe State Faults 186, 188, 190
Safe Stop 1 91
Safe Stop 2 91
Safe Stop mode 89
Safe Stop Reset
See SS Reset.
Safe Stop Types 90-92

Safe Stop with Door Monitoring mode 102
Safe Torque Off with Standstill Checking 90
Safe Torque Off without Standstill Checking 92
safety certification
TÜV Rheinland 13, 199
safety functions overview 23
safety information 30
Safety mode 24, 74
slave combinations 139
safety reaction time 18
overspeed response 75
safety-lock 153
serial communication
DriveExecutive software 221
DriveExplorer software 218
Serial converter
catalog number 217
serial converter 218
set parameters
using a HIM 214
using software 217
Signature ID 153, 158, 159
SIL 3 9, 13, 199
SIL 3 certification
user responsibilities 14
single encoder configurations 82
single-channel operation 57
Slave, Safe Limited Speed mode 132
Slave, Safe Limited Speed Status Only mode 135
Slave, Safe Stop mode 127
SLS Reset 74, 107, 113
automatic 106, 107
manual 107
manual monitored 107
SLS with Door Monitoring and Enabling Switch Monitoring mode 118
SLS with Door Monitoring mode 111
SLS_Command output 71
SLS_In input 60, 107
SLS Reset 107, 113
SLS_Out output 65
hold last state 121
SLS_Status output 71
spacing 32
specifications
encoder 199
environmental 198
general 197
Speed Hysteresis 120
speed resolution 75
speed value display 80
SS Reset 74, 95-96
SLS with Door Monitoring and Enabling Switch Monitoring mode 118
SS_In input 60
SS_Out output 63
Standstill Position Tolerance
definition 94
Standstill Speed
definition 93
status attributes 192
status indicators 185
stop category
definitions 15
Stop Category Faults 189, 191
Stop Delay
See Max Stop Time.
Stop Monitoring Delay
definition 89
Stop_Command output 71

T

terminal block
remove 33
terminal screws
connections 34
torque 34
timing diagram
Safe Limited Speed 106
Safe Limited Speed Status Only 120
Safe Stop 1 92
Safe Stop 2 92
Safe Torque Off with Standstill Checking 90
Safe Torque Off Without Standstill Checking 93

U

USB converter 218

V

validation
third-party 159
verify
configuration 159
lock status 159
Signature ID 159

W

wiring
DC_Out output 67, 68
DM_In input 67
input examples 59
LM_In input 67
low profile connectors 51
MP_Out output 69, 70
multi-axis connections 64, 65
reset_In input 62
RL_In input 63
wiring example
Safe Limited Speed mode 109
Safe Limited Speed Status Only mode 122, 124
Safe Stop mode 102
Safe Stop with Door Monitoring mode 104
Slave, Safe Limited Speed 133-134
Slave, Safe Limited Speed Status Only mode 135-137
Slave, Safe Stop mode 129-130
SLS with Door Monitoring and Enabling Switch Monitoring mode 119
SLS with Door Monitoring mode 112
SLS with Enabling Switch Monitoring mode 115

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